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S. D. KIRKPATRICK, Editor

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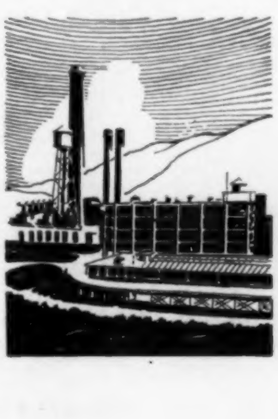
Dangerous Economizing

THROUGH the good offices of the National Safety Council, chemical industry has been able to set and maintain high standards of safety. Safe-practice pamphlets and bulletins are now available on every phase of plant operation—from unloading acid tanks to guarding open manholes. Yet one of the most dangerous elements in the whole situation has somehow been neglected. We refer to certain short-sighted managerial policies that have arisen during the present depression.

SOME of these involve real hazards to life. For example, not long ago a large process industry had two explosions within two weeks—one resulting in the death of a half dozen men and more or less serious injury to a score of others. Confidential inquiry among the technical men at the plant revealed the fact that much of the process equipment was so poorly maintained that well-informed employees purposely refrained from lingering in its neighborhood.

IN ANOTHER INDUSTRY, where high temperatures and pressures are employed, the night foreman complained to the management because his force had been so far reduced that, even with the best of organization, it would be impossible to protect the plant in case of fire or similar emergency. The man was told that other identical plants in the industry were operating with even fewer men, and that it was just one of the risks that had to be taken in times like these!

OTHERS of these short-sighted practices involve only the hazard to property. A survey of a thousand plants just completed for a large belting manufacturer showed, among other things, an increasing tendency to neglect many minor repairs and replacements. Rather than spend the few dollars required to replenish a storeroom stock, the operators were permitted to remove the belts and other accessories from idle machines in a near-by unit. This practice has continued until in a number of plants a large proportion of the equipment is now badly in need of repair.



A SIMILAR SITUATION was reported to us last summer by a manufacturer of refractories. An investigation proved that stocks of his product in the plants of many of his customers were entirely exhausted. Some of them had resorted to the makeshift practice of tearing down boiler settings or removing other furnace linings in order to get the bricks or shapes required to take care of immediate needs. When business gets even a little bit better, it is this manufacturer's sanguine prediction that there will be a real shortage of refractories—and a long delay in building consumers' stocks.

ORDINARILY we have little sympathy with Buy Now!—Build Now!—or Spend Now! campaigns because most of them are but artificial stimulants promoted for the selfish benefits of the local tradesmen or building contractors. Yet the admonition which we hear less frequently, to *"Buy Normally"* does not seem inappropriate, particularly when that buying is so directly in the self-interest of the buyer. Quite apart from its effect on the general business situation, the abnormal curtailment of industrial expenditures for necessary maintenance and repair of equipment must be strongly condemned by all who have at heart the best interests of their business and profession. The few dollars that a few companies have saved by such dangerous economizing is already overbalanced by a much greater loss of life and property.

EDITORIALS

OCTOBER, 1931

Chemical Industry Takes the Lead

BY OPENLY advocating and courageously adopting the six-hour shift as a means of spreading employment, the Manufacturing Chemists' Association has placed chemical industry at the forefront of progressive management in the present emergency. When the word of approval went out from Chairman Huntington's meeting with President Hoover, it set in motion a program that should result in distributing work among perhaps a third more wage earners in chemical plants. Inquiry also reveals that other companies outside of chemical industry are following this commendable example.

There are some, of course, who would raise a note of caution against a precedent that might, with the return to normal times, lead to a demand for increased wages—in other words, the request to pay as full a weekly or monthly wage for six-hour service as was formerly paid for eight hours. That is, after all, a bridge that need be crossed only after we come to it. Meanwhile, here is an entirely practicable scheme that promises to do much for the relief of those who would otherwise suffer real distress during the coming winter.

Gerard Swope's Proposal to Business

FOR generations we have been endeavoring to stabilize business in general by the individual efforts of the enormous number of concerns that make up American industry. But little of a constructive nature has been accomplished and we are continuing to experience great peaks and chasms in production and employment. Now Gerard Swope has had the initiative and courage to come forward with a well-developed proposal for stabilization through the united efforts of national groups of industries. This revolutionary plan includes, first, the regulation of production by means of trade associations, with federal supervision to protect the public from possible exploitations, and second, the regularity and continuity of employment with unemployment insurance as a reservoir of safety.

As would be the case with any plan involving regulation of prices and production, there are several aspects that will have to be thoughtfully considered before it can be put into effect. There must be either revision or repeal of the Sherman anti-trust law, and a means must be provided for compelling individual companies to enter the plan. The public must be assured that the plan will not deliver control of business into the jurisdiction of the government to the extent that a socialistic form of government would result, and, on the other hand, that it would be protected against monopolistic industry.

These objections are not so serious that they outweigh the desirable features of the plan, including concerted action on the part of a large and powerful group to stabilize industry, assuring business a fair return on its investment, and workers a fair wage for their efforts, removing from their minds the paralyzing influences of fear of sickness, unemployment, and old age.

Conditions have so changed since the passage of the anti-trust laws that it is impossible to distinguish between employer, employee, and investor. The prosperity of the individual enterprise has become closely tied up with that of its competitor. It is to be hoped that the troubles of the individual concern during this disturbing period will not make it forget that even as a matter of good business it should try to see its neighbors through. Therefore a united effort to stabilize industry through the Swope plan or some similar scheme would seem to be well worth the experiment.

How Much Is the Engineer Worth?

NO really reliable system for measuring the value of a technically trained man has ever been devised. This is not, of course, a disadvantage peculiar to the training he receives, for it is the case with every kind of service to a greater or lesser extent. Very largely the ends he has sought to achieve—stability, high standards of living, personal responsibilities—have taken his services out of the commodity class, prevented free competition, and virtually nullified, so far as he is concerned, the laws of supply and demand. As a consequence, his remuneration has become more a matter of what he can get than what he is worth.

Recent surveys, of which the one just completed by the American Society of Mechanical Engineers is the most imposing, make possible a very interesting pre-depression study of engineering earnings, and in comparison with older data allow the engineer to view his position relative to the other professions and to business. The findings confirm earlier beliefs that the engineer as a class has lower earning capacity than the lawyer and the business man. True, there are many extremes comparable to the better paying forms of activity, but the typical engineer does not find himself in the higher salary brackets unless he has developed managerial or consulting ability. On the other hand, he is definitely in advance of the teacher and the minister, and possibly of the physician as well.

For the sake of comparison, the following tabulation shows median earnings of college graduates in general, engineers, lawyers and physicians:

Comparison of Median Earnings[1]

Years Since Degree	College Graduates[2]	Mechanical Engineers[3]	Chemical Engineers[4]	Lawyers[5]	Doctors[5]
1	$1,650	$2,000	$1,800	......	......
5	2,550	2,800	2,700	$2,900	$3,200
10	3,800	4,000	4,100	3,900	4,100
15	4,800	5,100	......	......	......
20	5,850	6,000	......	8,578	4,950
30	8,300	7,000	......	11,000	6,000

[1]Salary of the median man, intermediate between the upper and lower halves of the group.

[2]Average of medians, Yale Department of Personnel study (1929); selling positions not included.

[3]From data on over 9,000 A.S.M.E. members, reported September, 1931.

[4]Preliminary report presented by A. H. White before the A.I.Ch.E. Conference on Chemical Engineering Education, July, 1931.

[5]E. W. Lord, "Relation of Education and Income," 1928.

Another survey of more than 5,000 engineers, made in 1924 by the Society for the Promotion of Engineering Education, shows close agreement with the engineer-

ing studies listed here. A survey recently conducted by Carnegie Institute of Technology among its graduates bulks somewhat larger for most engineering groups, although individual returns are frequently too few to permit broad conclusions. A University of Buffalo investigation of 40-year-old professional and business men, reported in 1926, shows good agreement for the engineers, but differences in salaries of medical men and lawyers. Here engineering earnings of about $5,400 contrast with income of $9,500 in medicine, $8,000 in dentistry, $6,600 in law, $4,000 in teaching and $3,500 in the ministry. For all professional men investigated, the median is $6,200, comparing not unfavorably with that of $6,700 reported for business men.

If there is any conclusion to be drawn from these findings, it lies in the evident superior bargaining power of the manager and the consultant. Obviously such ends can be attained only by the few, but for engineers as a class the first fact-finding steps for their economic betterment have been taken. What use they can make of the information must depend on their own efforts.

Nitrogen: Trouble Maker

NITROGEN refuses to become a peaceful citizen. The explosive proclivities that once came in so handy refuse to be subdued in times of peace. A perennial trouble maker for chemical industry, nitrogen continues to run the gamut of front-page news—from Antofagasta to London, from Muscle Shoals to Berlin.

Things are not going any too well with the nationalized nitrate industry in Chile. Where six months ago the enemies of Cosach were being clapped into jail or quietly exported from the country, these same individuals are now leading a very popular revolt against those who were responsible for the original scheme. The whole procedure under which Cosach was formed is being officially investigated and it is fairly certain that there will be some important modifications of the law when the new administration comes into power.

Opposition also is developing elsewhere. A protest meeting of English and French holders of preferred shares in Lautaro Nitrate Co., Ltd., was recently held in London and *The Times* of that city for Sept. 12 reports a highly accusing—almost libelous—attack on certain individuals, who, it is asserted, had used high-handed tactics in conducting Cosach's affairs in their own self-interest. Judging from this account, it would appear that even the official power of public taxation had been invoked not only to meet the government's guaranteed dividends but also to pay off the private debts of one of the less successful companies. Interesting as this little quarrel is to the outside observer, it can perhaps best be left to work itself out within the nitrate family.

But in the meantime, the price war that followed the failure of the International Cartel has spread rapidly to all consuming countries. As pointed out in the article from the *Frankfurter Zeitung* reprinted in part on page 582 of this issue, the synthetic producers have finally decided that they cannot afford to give quarter any longer to the natural product.

New price schedules vary widely in different parts of the world. Formerly there was a world level of nitrogen prices for fertilizer raw materials. Now there seem to be developing as many price schedules as there are political subdivisions involved, each schedule affected by local tariff or import restriction policies. The United States remains virtually the only really free market of significant size. Here the battle is going to be, as usual, between ammonium sulphate and sodium nitrate. But it happens that each of these two major commodities is a twin. The nitrate may be Chilean or it may be synthetic; the sulphate may be byproduct or it may be made in mixed fertilizer by ammoniation of the superphosphate. Unquestionably all of the byproduct ammonium sulphate is going to sell. Producers will put their prices low enough to insure reasonably prompt marketing. Whether the synthetic ammonia producers are going to more than meet the prices fixed on imported Chilean nitrate is not yet evident. Only the farmer will benefit from this price war, and apparently he is not in position to buy much fertilizer during the coming year. Some even predict another 40 per cent cut in total consumption as compared with the last fertilizer season. Frankly, we hope the decline will not be as heavy as that, for it adds another disturbing element to our nitrogen troubles.

Chem. & Met. at Home— 330 West 42d St., New York

WITH this issue, *Chem. & Met.* must bid farewell to the home which, through the past eleven years, has been the scene both of its unfolding destiny and of pleasant calls from a gratifying number of friends. That its future history will henceforth transpire under new auspices may—at least, so we hope—interest its readers, but to those who may favor us with personal contact it will be a matter of practical information. The McGraw-Hill Building, to whose 29th floor *Chem. & Met.* will be promoted late in October, is to be seen in the adjoining illustration.

To its readers, in a sense, *Chem. & Met.* owes many of the unusual features of the new structure. The ceramic industry has produced the glazed green terra-cotta tile which determines its whole appearance; glass provides half of the exterior surface. Nitrocellulose lacquers have furnished the main medium of interior decoration on metal partitions and plaster walls, while resin-base paints protect and coat all exterior structural steel. Metals have also contributed the bronze and stainless-steel trimmings, the silicon-iron acidproof drain pipe, the molybdenum-alloy fume ducts. Cork and a resilient plastic help to prevent vibration from heavy printing machinery, and of course, linoleum was chosen to cover the floors.

Scarcely a chemical museum, but a hint, at least, of how far the chemical engineer's influence has progressed in a decade. And it has now made it more agreeable for *Chem. & Met.* to welcome him to this new, more attractive home.

CYANAMIDE PRODUCTION REDUCED BY

By JAMES A. LEE
Assistant Editor
Chem. & Met.

For years the cyanamide industry in America has operated behind closed doors. Not since Chem. & Met.'s description in 1919 of the Muscle Shoals plant has any journal published a first-hand technical account of the interesting progress that has been made in this field. Therefore, it is with justifiable pride that Chem. & Met. presents another "first article" to its readers. Others in this growing list have included the Arvida (Canada) plant of the Aluminum Co. of America, Westvaco at Charleston, the hydrogenation plants of Standard Oil at Bayway and Baton Rogue, and the new Merrimac chemical plant at Everett.—THE EDITOR.

MODERNIZATION and improvement of a plant as a part of remodeling and enlargement has been the consistent policy followed in the American Cyanamid Co.'s calcium cyanamide plant at Niagara Falls. This works demonstrates convincingly the economic advantage of mechanized material handling, larger size electrical and mechanical units in the process equipment, straight-line flow in processing, and a variety of other improvements in both electrochemistry and chemical engineering.

The original plant, build in 1909, had a production capacity of 5,000 tons of calcium cyanamide per year. Much of the increase from this capacity has been achieved by redesign for straight-line flow carried out under George E. Cox, superintendent of these Niagara properties. The enlargement initiated in 1913 from a capacity of 24,000 tons was intended to permit an output of 48,000 tons, but actually resulted in a 60,000-ton capacity. Two subsequent major additions and improvements have brought the capacity up to approximately 355,000 tons, equivalent to 75,000 tons of contained nitrogen. All this expansion has been accomplished without requiring any significant increase in the number of employees since 1909. In this plant, which at capacity operation employs 525 persons, including those in office, laboratory, shops, restaurant, and auxiliary divisions, practically all manual labor in handling raw materials, materials in process, or finished products has been eliminated.

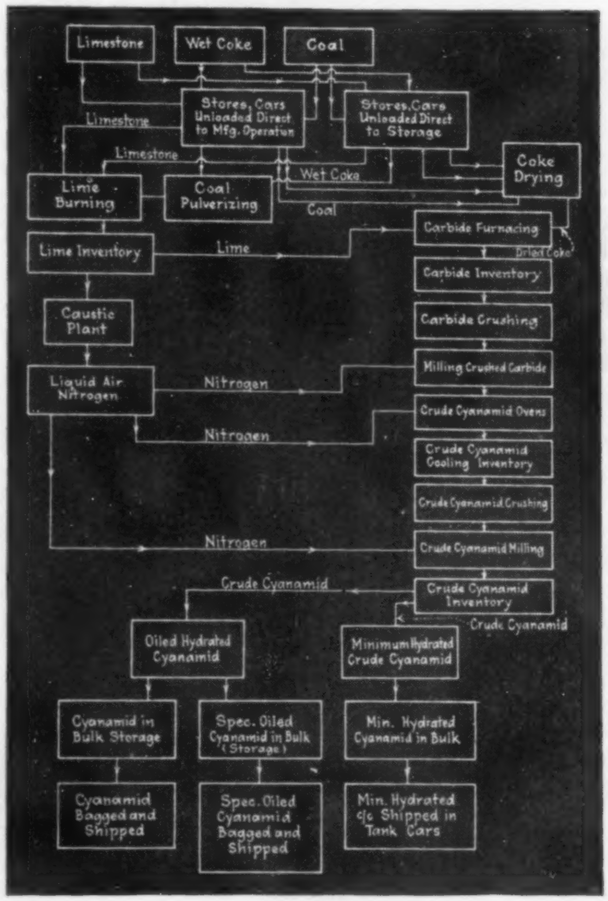
Electrical and materials efficiencies also have been greatly improved. Originally, 20,000 kw.-hr. was consumed per short ton of nitrogen fixed; at the beginning of the World War 16,000 was required; now approximately 9,000 suffices, including the requirements for all plant operations and auxiliary services. During the twenty-year period of development the limestone requirement also has been reduced, from 7.5 to 4.8 tons of stone per short ton of nitrogen fixed; and the coke consumption has improved, too, from 3 to 2 tons per ton of nitrogen.

Cyanamide manufacture can be conveniently divided into four principal operations, or series of operations: burning of lime, carbide manufacture, separation of nitrogen from liquid air, and nitrification of the powdered carbide with this nitrogen. In each of these major divisions of the work at Niagara are important and interesting new chemical engineering practices.

Limestone, the bulkiest raw material used, is obtained from the company-owned quarry at Beachville, Ontario, where the stone is crushed and ground to furnish the desired ½- to 2-in. size. The net cost of this stone for cyanamide manufacture is materially reduced by the successful marketing of the fine stone made incidentally in a pulverized form for agricultural and feed uses.

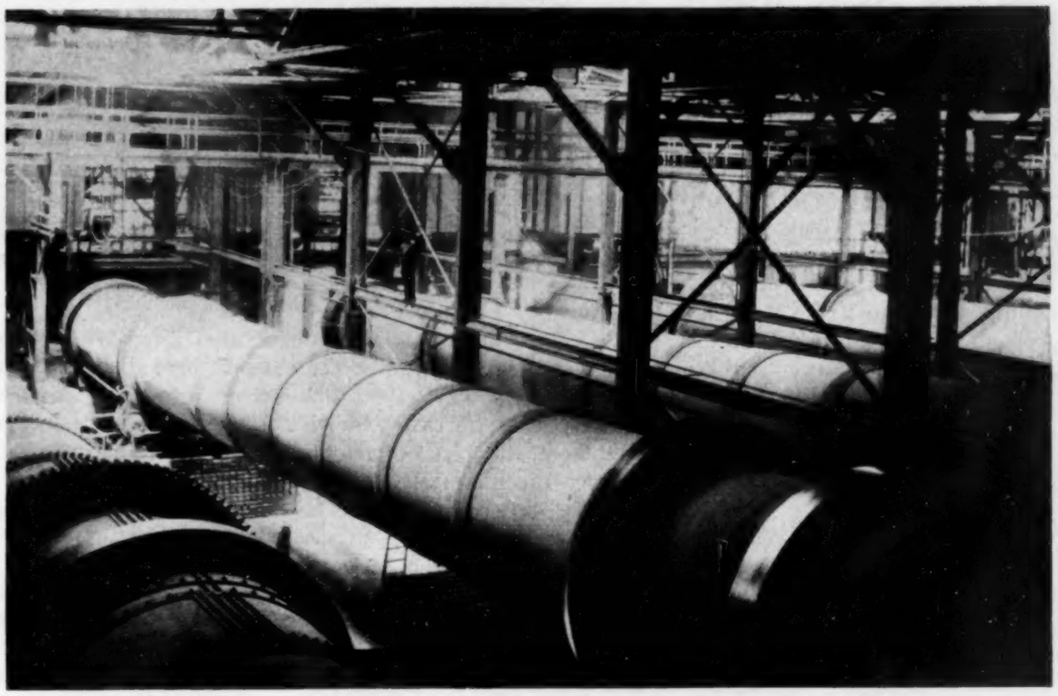
The kiln department is one of the showplaces of the plant. It is modern in every respect, consisting of seven 8x125-ft. inclined rotary kilns which a few years ago were installed to replace twelve vertical-shaft kilns pre-

Flow Diagram of Calcium Cyanamide Production



COSTS

MODERN EQUIPMENT



Battery of Seven Lime Kilns Looking Toward Control Platform at Firing End. Each Kiln Has a Capacity of 100 Tons of Lime Per 24-Hour Day

viously used. The change from vertical to rotary kilns has not only lowered production costs but has also resulted in a better quality control of the lime.

Each kiln has a capacity of 100 tons per 24-hour day. The drive requires 27 hp. per kiln; they are operated at one-half revolution per minute through a bevel-gear drive. The pitch of the kiln is 5 ft. in the total length of 125. Four workmen per shift care for all of the kiln department operations, but several workmen on the day shift care for unloading of the limestone and filling of the feed bins. The stone as charged averages 98.5 per cent calcium carbonate; it is burned to about 1 or 2 per cent carbonate with a fuel ratio in the kiln of 3 to 1.

Slack coal for firing the kilns is reduced in size first in an Erie City roll-type crusher and secondly in an Aero pulverizer. During the process of pulverizing coal is partially dried by utilizing waste heat given off by the hot lime as it leaves the kilns. A hood, 3x6 ft., has been suspended above the conveyor, which carries the lime from the kilns to the coolers, and the heated air is drawn through a pipe extending from the hood to the pulverizer and circulated through the pulverized coal. This same air is used for blowing coal into the kilns to effect the burning of the limestone. The powdered coal, burned in an air blast, maintains a maximum temperature of 2,200 to 2,500 deg. F., without material injury to the brick kiln lining.

The engineers ascribe their ability to obtain constantly a lime of unusually good quality to their means of controlling the temperature of the kilns. For years the temperature was controlled by radiation pyrometers on the firing ends of the kilns which indicated temperature in the firing sections of the kilns. But it was found that the temperature of the gases leaving the kilns bears a closer relation to the calcining operation; and therefore that if the temperature in the upper part of the kiln was kept constant, the quality of the lime would be more nearly uniform. Therefore, a Brown thermocouple was placed in the connection between the kiln and stack, and the kiln is operated to hold the temperature of the gases, leaving it at approximately 1,100 deg. F.

The seven kilns are served by a single Peck conveyor below the spouts at the discharge ends, which is composed of overlapping steel buckets so arranged as to carry the hot lime with a minimum breakage. This conveyor feeds two rotary coolers designed by the company engineers for a minimum of abrasive action during the cooling. These coolers are 8 ft. in diameter and open at both ends. The longitudinal steel plates which attach the inner cylinder and the outside shell divide the cooler into six compartments so that the hot material entering the coolers is segregated in the smaller compartments, resulting in less fall and less breakage of the lime. By means of the air circulating through the inner cylinder

Nitrifying Ovens of 8,000 Lb. Capacity Are Most Economically Operated; Crane Is Lifting an Ingot From One of the Ovens

and the water spraying over the outer, the temperature of the lime is reduced from about 1,000 to 300 deg. F. On leaving the cooler the lime is conveyed to a bin in the storage room adjacent to the carbide furnaces.

Coke, the other important raw material, is reduced in Beaumont crushers to the maximum size of 1 in. From the crushers it passes to the pulverized-coal-fired dryers, which were designed by the company engineers and built by the McGann Mfg. Co. Each dryer is equipped with an Erie City unit pulverizer and a combustion chamber. The temperature of gases entering the dryer is thermostatically controlled by the admission of outside air.

When dried the pulverized coke is carried to the raw materials building. Beneath the dried-coke and quicklime bins are scale hoppers which deliver the materials to a conveying-mixing belt by which they are carried to the carbide furnace room, where they are distributed among the furnace-feed bins. The mixed charge is dumped from these through chutes directly into the furnaces.

The carbide-making plant contains eight furnaces: four 4,000-hp. furnaces with a capacity of 22 tons of calcium carbide per day were built in 1913; six years later, two 16,000-hp. furnaces were installed which had a capacity of 98 tons per day each; and in 1928, the capacity of the plant was increased by the installation of two 30,000-hp. furnaces, each with a capacity of 185 tons. These larger furnaces have greatly increased the efficiency of this department. For every 1,000 hp. used in the smallest size only 5.5 tons of calcium carbide is produced, as compared with 6.1 tons made in the two large-size furnaces with the same power consumption. An additional advantage gained by the use of the larger furnaces is in the labor requirement per unit of product. The number of men is the same regardless of size.

The attention of even the casual observer is attracted by the giant electrodes suspended in the furnaces. The oblong assembly of five 20x22x100-in. carbons weighs complete with holder about 16 tons; a single set of carbons has a life of seven days. The assembly can be handled with ease, two workmen changing a set of electrodes in 15 min. The lowering of the electrodes into the furnace is continuous and automatic; a special attachment stops them when they have reached the previously determined danger point.

Power Distribution

	Approximate Hp.
Carbide furnaces	88,700
Cyanamide ovens	800
Liquid air plant	3,100
General service	3,800
Special chemicals and experimental	3,600
Total	100,000

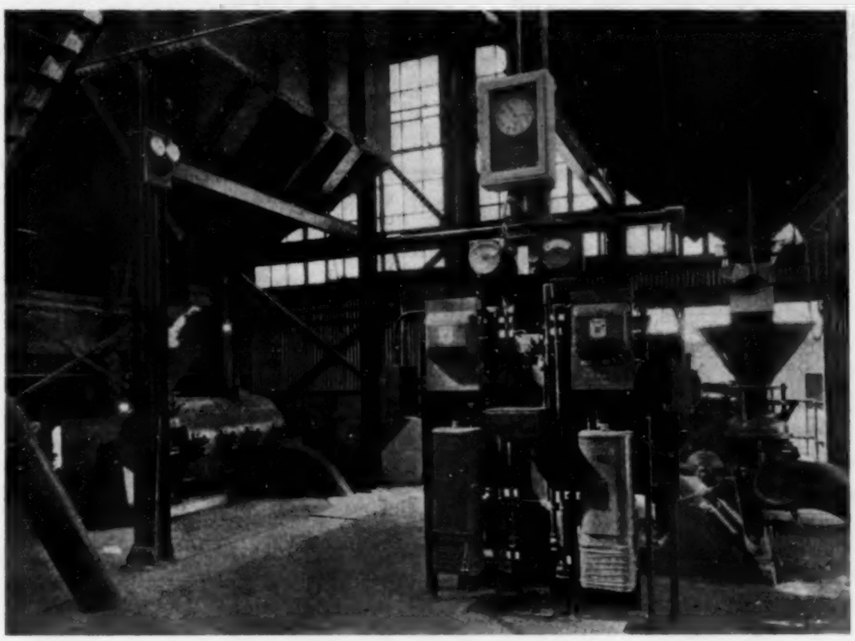
The charge, a mixture of lime and coke, is fed around the electrodes, from the bins above the furnaces, through swinging spouts. The rate of feeding is adjusted so that the furnaces are kept full at all times, compensating for the discharged carbide. The tremendous current of electricity passing between electrodes melts the lime, which combines with the coke, forming calcium carbide and carbon monoxide. The latter burns at the top of the furnace to carbon dioxide and escapes.

Furnaces of 4,000 hp. are tapped at one-half hour intervals, and the others almost continuously. Tap holes are opened by burning with a portable electrode or electric needle, and carbide at 4,000 deg. F. flows into chill cars of 2,000 lb. capacity. Several cars are pulled onto a truck by a gasoline locomotive, and the truck is moved along beneath the tap hole by a car puller, controlled by a pushbutton. When all cars are filled, the locomotive pulls them out to the cooling shed.

Nitrogen for use in making the lime-nitrogen and for replacing air in the carbide-milling system is separated and purified by the Claude process in the liquid-air plant located several hundred yards from the main plant. It is led directly to the fixation ovens and milling equipment through an underground cast-iron pipe.

In the milling department, the cooled carbide pigs are prepared for use in the nitrifying ovens. Pigs are reduced in size first in a primary crusher and then in a Symes machine which take them down to ½ in. in size, and a Com-Peb mill completes the reduction by pulverizing the carbide to 100 mesh. Due to the reaction of moisture and calcium carbide, forming acetylene, which is flammable when mixed with air, the milling is done in an atmosphere of nitrogen.

Like most of the other departments, the nitrifying equipment has passed through several stages of modernization. The original ovens installed at Niagara had a capacity of 600 lb. of carbide; those in use now have a capacity of 8,000. It has been found that ovens of this size are most efficiently operated. After being filled with pulverized carbide they are closed, and the nitrogen, piped from the liquid air plant, is turned on. Through an opening in the center of the cover a carbon



Coal Pulverizers and Electrical Control Equipment for the Lime Kilns Are Located on the Firing Platform

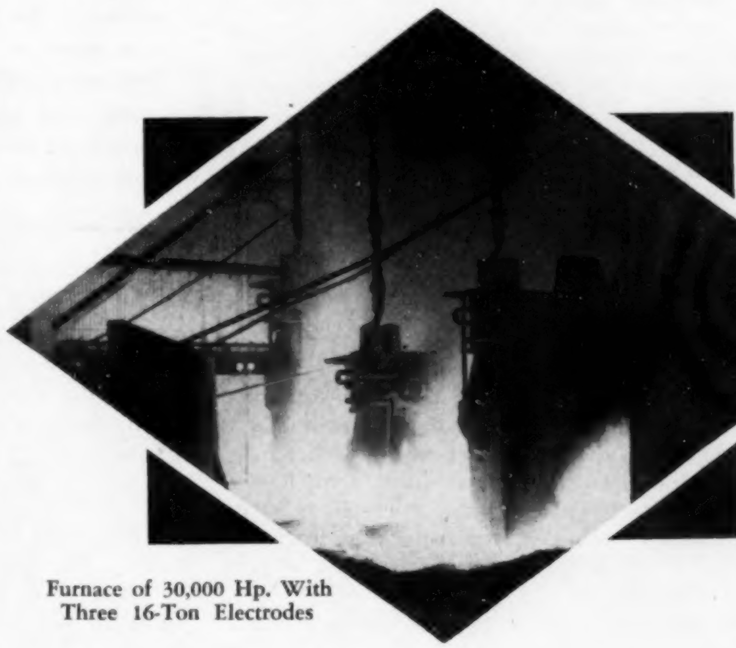
rod is inserted and heated to incandescence with the electric circuit. By radiation the surrounding charge of carbide becomes white hot. It absorbs the nitrogen, forming calcium cyanamide and free carbon, and since the reaction is exothermic it continues until completed.

After the oven is charged and started, no attention is necessary until it is ready to be discharged. The period of nitrification from start of oven to removal of cold finished product, known as lime-nitrogen, is about one day per ton of carbide charged. When the absorption has stopped, the crude cyanamide, which has sintered together, is removed by the crane operator and his assistant, who lift the cover, lower special tongs into the hole in the center of the pig left by the carbon rod, pick up the pig and transport it to a car at the end of the building. It is then carried to the cooling room, where it remains until ready to be crushed. The ingot of lime-nitrogen, weighing about 6 tons, is broken into several pieces which fall into a hopper and are delivered by a drag conveyor to a Williams hammer mill, which breaks it into 2-in. pieces. A second Williams mill completes the crushing. It is then conveyed by screw conveyors to storage or direct to the hydration plant.

The lime-nitrogen as produced in the cyanamide oven is composed of 25½ per cent nitrogen, or about 70 per cent calcium cyanamide; 12 per cent finely divided graphite, which gives it a slate-gray color; 18 per cent free lime; and miscellaneous impurities picked up from the coke ash, electrodes, and limestone. There remains from 1 to 2 per cent of unnitrified carbide.

This product is treated before marketing. For chemical purposes, or if to be used for production of ammonia, a small quantity of water is added as the fine cyanamide passes through a mixing-type screw conveyor, to decompose the remaining traces of carbide. It is then ready to be loaded into 70-ton hopper cars and sent to conversion plants. The product for agricultural purposes, commonly known as Cyanamid, is treated differently. It goes to a more elaborate mixing system where both oil and water are added. The water is used to decompose the carbide and to hydrate the major portion of the free lime. Oil is added for the purpose of preventing dustiness, in quantity equal to 4 per cent by weight of treated product. It is cooled by passing through a rotary cooling cylinder and sent to bulk storage.

No description of this interesting plant would be complete without at least some mention of the very efficient means for preventing a dust nuisance. The limestone is crushed and screened before being brought to the plant, and every effort is made in the lime-burning department to prevent abrasion of the lumps of lime, but the small quantity of dust that cannot be avoided is collected in Draco bag filters and used in the liquid-air department for regenerating caustic soda. Pulverized coke collected in the same manner is used with the powdered coal in the lime kilns, and the cyanamide dust collected at the crushing and milling equipment goes to the bagging department.



Furnace of 30,000 Hp. With Three 16-Ton Electrodes

Cyclone collectors installed above the carbide furnaces collect the large particles of dust that would otherwise pass up the stacks and spread over the surrounding country. As a result of these precautions the entire plant is clean and the company is spared embarrassing complaints from its neighbors.

A Well-Planned Patent Policy Pays Profits

By EDWARD THOMAS
Patent Attorney
New York City

Every business man has a conscious or unconscious policy for dealing with inventions, but the policy of many businesses needs broadening. Because of the rapid advance of chemical knowledge and methods, it is almost useless to attempt to practice processes secretly. Many patents are inadequately prepared and, in consequence, either worthless or likely to be involved in litigation. Between 10 and 20 per cent of all patents are worth while. Before granting licenses, careful study should be made of various possible licensing policies and their probable effect, and manufacturers, even of unpatented articles, should carefully study the concealed hazards which may be encountered when new inventions appear. Care must be taken to mark articles patented as provided by law and prompt notice given infringers. Inventions offered for sale should not be lightly refused. A research department usually has proved worth while, both for original developments and for investigating the value of inventions offered for sale. Resourceful attorneys at the beginning are well worth the price, in view of probable later developments; it is often possible to advantageously avoid a law suit; and adequate knowledge of what has been done in the past is often the cheapest way out of a difficult situation.

THE Ford Motor Co. and the General Electric Co. stand at opposite poles of the earth in dealing with patents. Records of the U. S. Patent Office show, for typical years, that the latter company takes out in its own name an average of a patent a day the year round, in addition to the patents taken out by subsidiaries. Some one with a fondness for figures has computed that this same company owns 12,000 patents including those purchased after issue, and estimates that 40 per cent are in current production. Book publishing seems to be the most comparable standard, and few book publishers would be able to say after 17 years (the life of a United States patent) that 40 per cent of the books they have published are in print and selling. Like old and superseded books, many of the General Electric patents must represent old and superseded inventions. Others, naturally, represent mistakes in counting as assets patents that proved to have no value. Besides these patents which it owns, there must be many patents on which it pays royalties to outside inventors.

At the opposite pole stands the Ford Motor Co. In one suit, for infringing a rust-proofing process, counsel for this company said: "There is no power on earth this side of the Supreme Court of the United States which would make Henry Ford sign a license agreement or pay a royalty." In that suit the Court ordered his company to pay $367,174.36 for infringing the plaintiff's patent. The Court held that the company was spared from paying $1,892,116.87 because it had successfully concealed the infringing acts from January, 1917, to September, 1920, and the law was construed as denying to the plaintiff the right to recover damages during this period because of failure to notify the Ford Motor Co. in the prescribed legal form that it was infringing this patent. That company operated in secret the process which it was sued for using, but manufacturers every year find it more and more difficult to keep the secret of a process.

The patent is offered by the government to a manufacturer as an alternative to secrecy, for a patent is really a 17-year monopoly granted in exchange for publishing what an inventor might have kept a secret. The chemical manufacturer, like all manufacturers, therefore has an interest in the possibility of patenting those improvements which in days gone by he probably would have kept as secrets. But a patent on a valuable invention may be either good and profitable, like the Bell telephone patent, or bad and profitless like the Grundy patent on the vibrating ribbon carrier used in practically all typewriters. The Grundy patent should have been worth several hundred thousand dollars. It should have dominated the typewriter manufacturers, but failed to, because it was limited to tilting spools for the printing ribbon, and no manufacturer ever wanted to build spools that tilted, so Grundy never collected the royalty the manufacturers would have gladly paid.

Engineers should not allow themselves to become discouraged by the tales of woe thus far related, for the profits probably are much larger than the losses.

In 1914, a cobbler invented a new type of rubber heel for shoes and in February, 1915, sold 6,696 pairs of the heels. He applied for a patent, the sales grew, and by June, 1918, was selling over 2,250,000 pairs a month, although his heel was not advertised well. The net profits of his business for 1917 alone had been $482,000.

His patent seems not to have been well prepared and several manufacturers found it possible to make almost the same heel without infringing the patent, but it nevertheless seems likely that the profits of the heel were over $1,000,000.

It is true that some large companies make a business of pirating inventions of others. A very large rubber company having a well-deserved reputation for such pirating was one of the infringers of that heel patent. Another large rubber company has an equally unenviable reputation. A very successful small organization engaged in general chemical research and a large corporation

producing coke and coal-tar distillates have similar unsavory reputations. But most of the large rubber companies and most of the other large manufacturers can be trusted to deal honestly with inventors, though they may drive a hard bargain.

It is generally accepted as an axiom, however, that a well-drawn patent will be respected by most organizations even by those called unscrupulous. The vast majority of attorneys advise their clients that to infringe deliberately a patent involves great peril, laying them open to a penalty of triple damages. Most litigation, therefore, is over poorly drafted patents.

Not only have various types of business organizations well-developed policies for dealing with patents and inventors but every person, every corporation, has some policy with regard to patents, even if it is only an unworded resolution to ignore them. But most policies for dealing with patents are arrived at without an understanding of the basic facts about patents, such facts as can be discovered only by studying litigation statistically.

I have elsewhere outlined a statistical study of patent litigation. I examined litigation so far as it concerned the first million patents issued by the United States, and showed that there were lawsuits on probably about 12,000, some patents being the cause of many suits—one is reported in 54 cases. This litigation probably represented one-ninth to one-fifteenth of the patents actually infringed. Besides these, there are many patents which were profitable, though never infringed, either because the owner supplied the entire market or because his willing licenses supplied that market. Thus about 20 per cent or more of issued patents must have been profitable. One patent was so profitable that its owners were sued for $17,000,000 damages on the ground that they had stolen the invention and had profited by it to that extent.

Hidden Hazards May Be Disastrous

It is, therefore, likely to be profitable for a manufacturer to deal constructively with patents and inventions, to have a well-defined and well-planned policy for dealing with them, if they touch his business or are likely to affect it. Most manufacturers should study carefully the concealed or hidden hazards their business may encounter, because new inventions may wipe out demand for their goods. Probably manufacturers of cotton goods could not have foreseen the advent of rayon.

Manufacturers in this age of progress may well learn a lesson from the history of diphenylguanidine as a rubber accelerator. In 1916, Dr. G. D. Kratz prepared a quantity of this material, then a costly product, established its efficacy as a rubber accelerator, and reported the facts to his employers, Norwalk Tire & Rubber Co. In 1917, he became chief chemist of Falls Rubber Co. and used diphenylguanidine in the manufacture of 300 tires which were sold. He made further tests of the same substance in 1918, and read a paper on the subject before a meeting of American Chemical Society on Sept. 6, 1919. Apparently Kratz's employers deemed the process too expensive to be worth patenting; at any rate there is no record of any patent issuing to him or them.

In July, 1921, Morris L. Weiss applied for a patent on a method of cheaply producing diphenylguanidine, and later applied for a patent on the process of using it as a rubber accelerator. Cheap diphenylguanidine soon became almost a standard article in vulcanizing rubber, but Weiss' patent for so using it was held invalid because anticipated by Kratz's work, so the process of using diphenylguanidine as an accelerator was open to anyone without infringing any valid patent. Rubber men have estimated that a well-drawn patent based on Kratz's discovery should have produced at least $3,000,000 in royalties, but his invention had been given away by failure to obtain a patent.

Part of an adequate and well-planned patent policy is a research organization provided with adequate laboratory and other testing facilities. The United States Steel Corp. announced in 1927 that it was about to organize a research department. After allowing other manufacturers to profit by research for 25 years, this giant corporation awoke to see a picture of the opportunities it had lost, and, for the first time, began to plan systematically a research program in an effort to solve its problems.

Small Company Beset by Difficulties

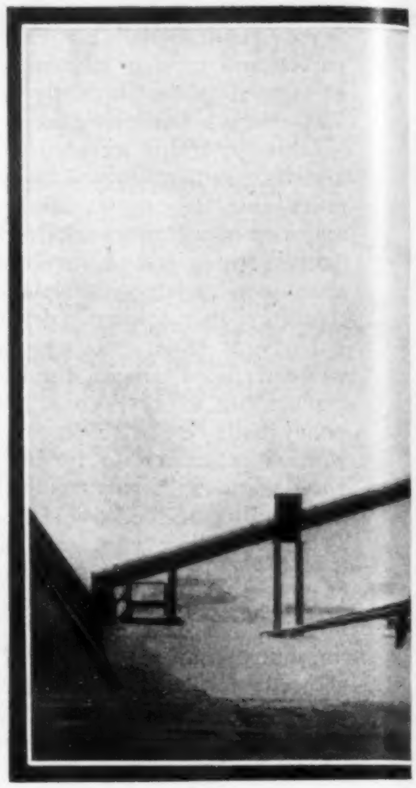
For a large company having many large and scattered plants the research and patent policy must differ from the policy of a small organization. In the case of many patented products, machines and processes, the large corporations—especially those of the type known as a "vertical trust," which covers all stages of production from the raw material to the "consumer's goods"—provide their own outlet or market to a large extent and thus are themselves the commercial measure of the value of the patent. The small organization, on the contrary, may have to estimate what it can market if it adopts any new invention. And the problem of understanding the market possibilities is enmeshed in many difficulties which can best be untangled by experienced research men.

Resourceful attorneys may seem high-priced at first, but they often save many times the extra initial cost of their services. Details of experiences in dealing with threats of suit against clients may be interesting. One case involved a patent covering what I will call leather. The client had a patent on the material having a peculiar, usually invisible, but valuable property. When this threat was received the client was told that the attorney was sure he could break the patent under which suit was threatened, for he was sure the patented material had been made, although the valuable property might have resided unnoticed in the product. He said the search would be long and expensive, because he did not know where to begin to search the literature and the patents.

Within a week after he was authorized to begin the search he had found a prior patent which produced exactly the article the client was making, although the process was used to produce a property his client cared nothing about, and, moreover, this patent said not a word about the property so valuable to his client. It was desirable that the threatener should not know of this patent, so the client authorized a further search and within a month the attorney had found a patent which described the process that the threatener's patent described, but did not describe the process of his client's patent.

The attorney showed this to the man who was threatening the client and he dropped his threats. This searching cost the client much less than a lawsuit. Moreover, a lawsuit would have advertised to the world the imperfections in all the patents involved without helping either party. By avoiding that advertising of imperfections in the patents the potential value of the patents of both parties was preserved.

Selecting Equipment For Electrostatic Precipitation



By R. H. KAUFMANN

Industrial Engineering Department
General Electric Co.
Schenectady, N. Y.

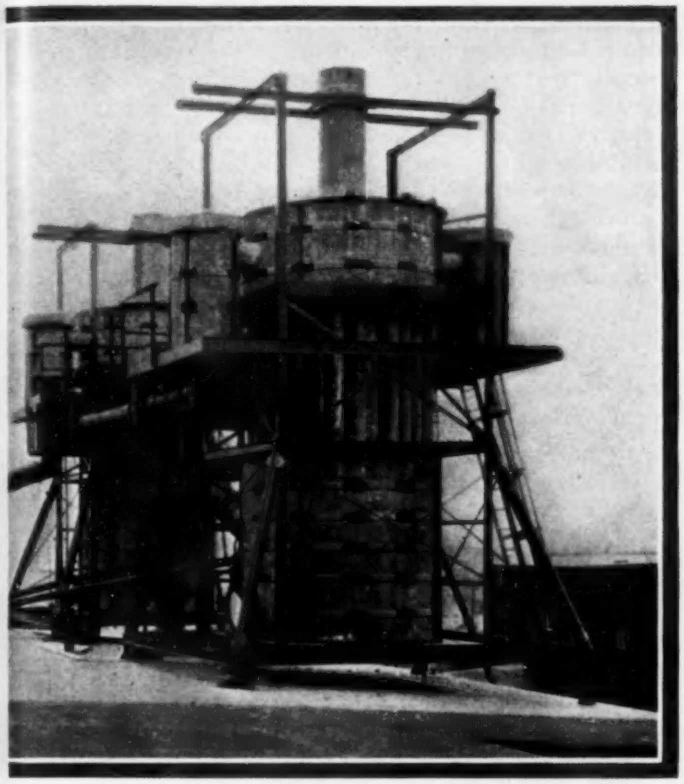
IN the early part of the nineteenth century the fact was first discovered that minute particles of material suspended in a gas could be precipitated electrically. The first commercial application of this phenomenon was made by F. G. Cottrell, in 1906, for the recovery of sulphuric-acid spray which escaped from vats of boiling acid. Since that time there has been a marked growth and expansion of the application of electrical precipitation. It is now commonly applied for the recovery of metal dust, such as copper, zinc, and lead; of cement dust; of food powders, such as milk, eggs, and sugar; for the removal of smoke or ash from boiler-flue gases; of tar from manufactured gas used for heating and illumination; and many others too numerous to mention. In general, electrical precipitation may be applied for the removal of any material in gaseous suspension, provided the substance is in the form of small solid or liquid particles.

The complete precipitation equipment consists of the treater, in which the suspended material is removed from the gas, and the power-supply unit, together with necessary control and protective features. The treater consists of a closed structure through which the contaminated gas is passed at relatively low velocity. The space within the treater housing is occupied by a network of electrodes. Positive electrodes are of large area and generally take the form of pipes or plates which are grounded, while negative electrodes are small and usually consist of wires or chains suspended within the pipes or between the plates and supported on insulators. The construction is such that the gas must travel through the space between positive and negative electrodes for the entire length of the treater. Upon the application of high-tension, direct current of proper voltage and polarity, the suspended material is precipitated on the positive electrodes. The complete treater usually is composed of several independent sections to permit removal of precipitated material without interrupting the process. While a given section is being cleaned, the gas flow is transferred to an active section.

A d.c. potential in the order of 25,000 to 75,000 volts is required by the process. Because of the peculiar characteristics of corona discharge, the number of units which can be successfully operated in parallel is limited and the most popular sizes of individual units are 15 and 25 kva.

Applications of electrical precipitation involve several peculiar characteristics. The application of high voltage to the treater elements produces ionization of the gas around the smaller, or negative, electrodes. Under this condition, a power current will flow between the electrodes which is essential to the operation of the device. The electron stream applies a negative charge to the suspended particles, after which they are drawn toward the positive plates, to which they attach themselves. Such a corona discharge is characterized by a decreasing effective resistance as the current increases. To obtain greater freedom from arc-over at a given current, it is desirable to introduce a drooping voltage characteristic in the power-supply unit by the addition of series resistance or reactance.

The main power generally is derived from one phase of the local a.c. distribution system. The proper a.c. voltage is derived by transformation, after which it is rectified and applied to the treater. With its array of electrodes the treater forms a capacitor which is charged to peak voltage at every impulse from the rectifier. During the interval between impulses, when no current is supplied by the rectifier, the stored charge maintains a current in the treater. Effect of the internal capacity is to intensify the current peaks taken from the rectifier and to produce a more uniform voltage at the treater. If there were no capacity in the treater, its voltage would follow the rectifier voltage and the current from the



Cottrell Precipitation Treater for Recovery of Sulphuric-Acid Mist

rectifier would be distributed over the entire cycle. Assuming infinite treater capacity and no series resistance or reactance, the treater voltage would remain at the peak value of the rectifier voltage and the rectifier would supply current impulses of very large magnitude and short duration at the point of peak a.c. voltage. The actual condition is between these extremes. This characteristic is particularly important in the proper application of vacuum-tube rectifiers.

The static capacity in the treater and inductive reactance of connecting circuits and transformer windings constitutes a circuit in which oscillation will occur if a sudden change in current or voltage occurs. The frequency of such an oscillation will correspond to the natural resonant frequency as determined by the inductive and capacity reactance. Spark discharges at the treater, or at the segments of a mechanical rectifier, produce the necessary current impulse to cause oscillation, intensity of which depends upon the magnitude of the current impulse and resistance in the oscillating circuit.

Such high-frequency oscillations might produce abnormal voltages in inductive parts of the circuit and cause insulation failure. If the high-tension feeders to the treater parallel other lines, such oscillations will induce a voltage in the parallel circuit. The question of radio interference is another phase which may be important in some installations. High-frequency oscillations produce abnormal turn-to-turn voltages in the transformer, particularly at the end sections of the winding.

Protection of apparatus and circuits from the effect of oscillations is accomplished by proper damping effect in the form of series resistance. The degree of damping should be only sufficient to protect the apparatus from injury and to meet such other requirements as may exist, since additional series resistance means additional losses and lower efficiency.

The high-tension d.c. supply for treater operation can be obtained from:

1. Low voltage a.c. generator with transformers and synchronous rectifier.
2. Multi-winding high-tension d.c. generator.
3. Normal a.c. distribution circuit with step-up transformers and—
   (*a*) Synchronous mechanical rectifier.
   (*b*) Vacuum-tube rectifier.

Where a source of a.c. is not available, the first method is applied and was used to a considerable extent in early a.c. installations because of difficulties encountered in equipments which were arranged to excite the trams and drive the rectifier motor direct from the a.c. distribution circuit. The generator may be either belt-driven or direct-connected to its prime mover, and a mechanical rectifier may be direct-connected to the generator shaft.

At present, a.c. distribution systems are of relatively large capacity with satisfactory wave form, and power supply is almost universally taken direct from the a.c. system.

The multi-winding, high-tension a.c. generator employs a number of armature windings, brought out to separate commutators, which in turn are all connected in series to obtain the high-tension output. Such construction is subject to many disadvantages. Individual generator coils require heavy insulation to ground. The many commutators require considerable maintenance and constitute a potential source of trouble. High-frequency oscillators are difficult to protect against. High first cost and excessive maintenance make this construction uncompetitive.

The arrangement using the normal a.c. system with step-up transformers and rectifiers is by far the most generally used today. The transformers are of special design, both mechanically and electrically, for this class of service. Frequent short-circuits make greater mechanical strength necessary to insure satisfactory life. The possibility of high-frequency oscillation requires greater insulation, particularly at the end sections of the high-tension windings.

A typical synchronous motor-driven mechanical rectifier consists of a four-arm rotating member mounted directly on the shaft of a small 1,800-r.p.m. synchronous motor. Such a unit produces full wave rectification on a single-section, high-tension transformer winding. The least expensive synchronous motor for driving the rectifier is obtained by milling slots in the rotor of a 3-phase, squirrel-cage induction motor. Although the synchronous horsepower is much lower than the capacity as an induction machine, it is less expensive than the conventional type of synchronous machine and requires no d.c. excitation.

Vacuum-tube rectifiers offer another means of converting to d.c. The usual tube for this type of service consists of a glass bulb in which is mounted a cathode in the form of a filament and an anode which may take the form of a cylinder around the filament or a disk located a short distance from the cathode. The two filament leads are brought out to terminal pins in the base, while the anode lead is brought out to a cap at the top of the tube. Upon heating the filament to the proper temperature, negative electrons in large numbers are emitted.

With a positive potential applied to the anode, the electrons will be drawn to the positive electrode, producing a current flow. The current can be no greater than the rate of electron emission from the filament, and any attempt to pass a greater current will result in severe heating within the tube.

The vacuum tube has four important characteristics; namely, the voltage drop required to pass normal current; the peak-inverse voltage, which can be withstood in the direction opposite to current flow; the average current rating, as limited by heating and life; and the peak current, as limited by filament emission. The proper application of vacuum tubes requires that none of the latter three limitations be exceeded.

For precipitation service, it is quite common to mount the tubes directly on the transformer cover with the filament excitation transformer located within the main transformer tank.

Half wave rectification requires essentially only one tube, generally located in the ungrounded side of the transformer high-tension winding, in order to limit the voltage stress from transformer winding to ground. This connection gives only one current impulse every cycle, which means a lower average voltage for the same peak value, the latter being limited by arc-over in the treater. This feature adversely affects treater efficiency, and full wave is generally used for commercial service.

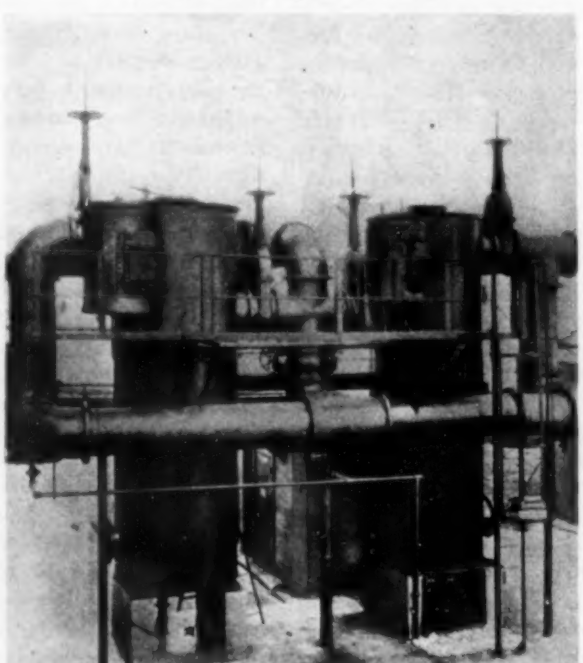
Full wave rectification may be secured with two tubes and a 2-section, high-tension winding, or with four tubes in a bridge circuit with a single-section.

The first connection requires that each of the two sections of high-tension winding produce normal voltage. Current is alternately drawn from first one and then the other section at half-cycle intervals, giving a 70 per cent utility factor on the secondary winding. The latter connection secures a 100 per cent utility factor on transformer windings, but requires four tubes. Each tube is subjected to only half the peak inverse voltage of the first connection, but there always are two tubes passing current in series, each of which will consume the normal tube drop, as is evident.

The ultimate choice of circuit depends largely upon the voltage and current ratings of the tubes, the cost of tubes and associated exciting transformers, the cost of the main transformer, and the over-all performance characteristics.

Each unit equipment generally is provided with a unit-control panel. An automatic oil-circuit breaker or contactor with overload relay is included for the transformer control. Instruments generally consist of an a.c. voltmeter and ammeter and may include a d.c. milliammeter in the ground side of the high-tension circuit.

Removal of Tar and Residues From Gases in Cottrell Precipitation Treater



With mechanical rectifier equipment a reversing switch is required in the primary circuit of the transformer to permit the proper high-tension polarity to be secured, regardless of how the synchronous motor came into step. The present tendency is toward semi-automatic dead-front construction with pushbutton controlled contactors to replace all knife switches.

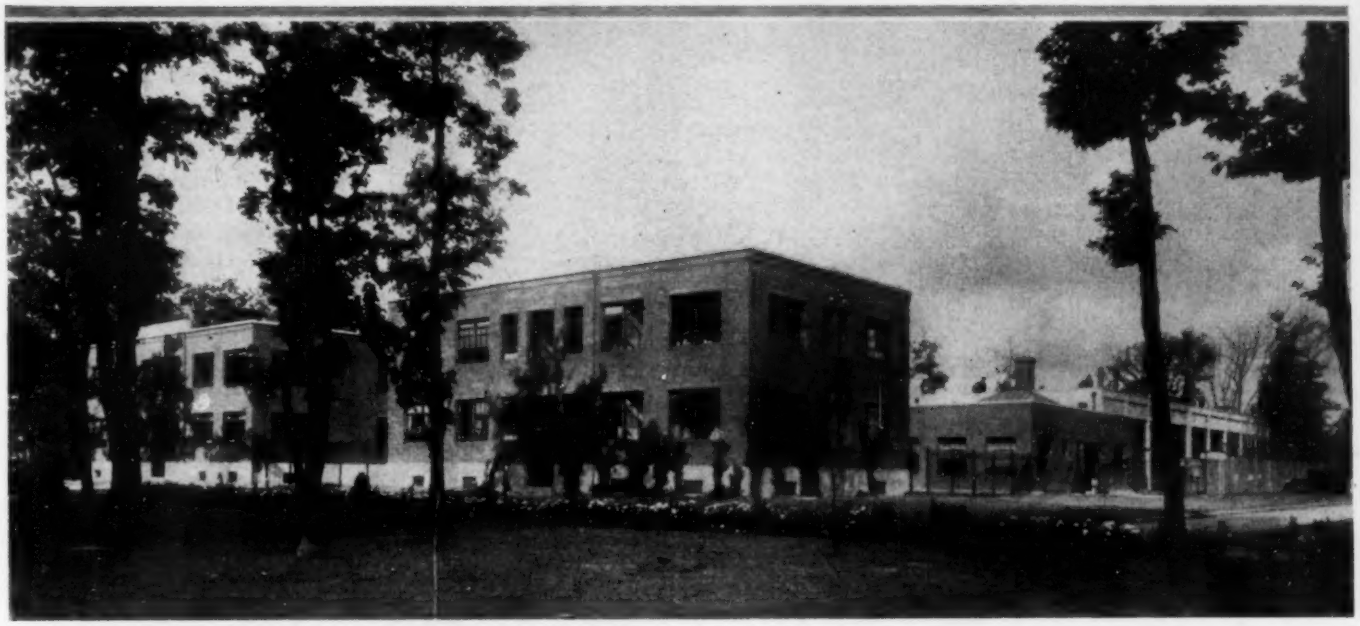
With the general adoption of magnetic contactors, the next improvement consisted of the addition of an auxiliary device to establish and maintain proper output polarity automatically by control of the transformer primary reversing contactors.

Vacuum-tube rectifier control panels do not require polarity control of any form, since the tubes themselves are unidirectional devices. Provision is made for control and adjustment of the filament-exciting circuit and instantaneous overload relays are provided to protect tubes against overload. Underload relays in the filament circuit should be included to remove power in case of a burnout of one tube filament.

Arc-over in the treater may sometimes result from a momentary overconcentration of water vapor or foreign material in the treater. Arc-over may result also from an accumulation of dust over an insulator which may be expelled when arc-over takes place. In either case the breakdown is of a transient nature and power may be immediately re-applied. The mechanical rectifier equipments usually are protected with ordinary overcurrent relays set considerably above normal current, while the vacuum-tube equipments are protected by sensitive instantaneous overcurrent relays set just above normal current, due to the definite limitations in the tubes. Vacuum-tube units consequently trip out more frequently than the mechanical units and it is customary to include standard reclosing features. A solid fault will cause lockout after a definite number of reclosures.

The application of electrical precipitating equipment is constantly invading new fields, for the elimination of nuisances as well as for the recovery of valuable material. Fractional precipitation has been applied for separation of materials by treatment first at high temperature when only a portion of the foreign material is in solid form, the remainder being in a gaseous state. Subsequent treatment at successive lower temperatures removes other groups independently.

There is a marked tendency toward the elimination of the smoke nuisance. The elimination of the smoke screen which blankets the average industrial center of today will effect a benefit to society well worth the effort to attain. In any case where perfect combustion of fuel cannot be realized, electrical precipitation offers a ready solution to this problem.

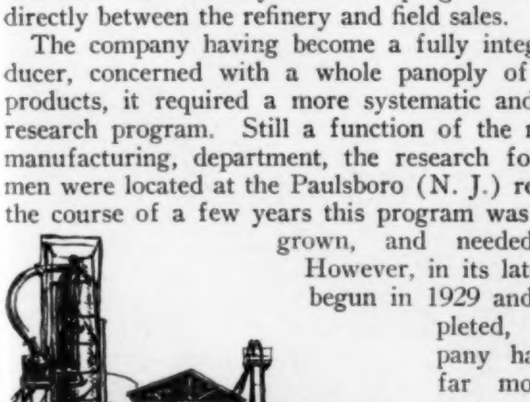


Transforming Faith in Research to A Concrete Conviction

Recognition by the Vacuum Oil Co., Inc., that, whatever the momentary course of business, the petroleum refinery is not only chemically operated but a rapidly growing chemical producer itself, has resulted in the engineering research facilities described and illustrated on these pages.

APPLIED RESEARCH in the petroleum industry had in effect begun as soon as a use for any of its products was first found: kerosene for illumination, heavier oils for lubrication, gasoline for combustion. In the case of Vacuum Oil Co., Inc., this dates back 65 years, when residual oils after distillation were applied to machine lubrication. Out of this activity gradually grew a specialized occupation with the heavier petroleum fractions, eventually achieving for the company a unique position in the lubrication field. To this end the necessary technical progress was effected directly between the refinery and field sales.

The company having become a fully integrated producer, concerned with a whole panoply of petroleum products, it required a more systematic and expanded research program. Still a function of the refinery, or manufacturing, department, the research forces of 40 men were located at the Paulsboro (N. J.) refinery. In the course of a few years this program was again outgrown, and needed revision. However, in its latest project, begun in 1929 and just completed, the company has made a far more significant present and future commitment to research.



As a first step, the refinery was unburdened of its experimental obligation and a separate research and development department was created as a major coordinate of the company. Then the facilities of the new department were considerably expanded, with, finally, a greatly increased staff to carry on the work adequately. In the fulfillment of these objectives, after two years, the company possesses a powerful experiment unit, the functions of which can now be viewed in greater detail.

The laboratories themselves are directed by Harry A. Curtis, chief of research and development, with the assistance of W. F. Faragher and B. W. Story. The activities fall into logical divisions (such as chemical engineering, mechanical engineering, physical research,

H. A. Curtis W. B. Ross B. W. Story W. F. Faragher

Leaders in the New Research Organization of Vacuum Oil Company, Inc. Dr. Curtis, Dr. Faragher, and Mr. Story Are Located at Paulsboro, Mr. Ross in New York

patents, and the like), each conducted by a responsible head and located in suitable quarters.

Selection of the more important subjects to be worked on is under the guidance of a research committee composed of representatives of the company's major departments, who thereby maintain close working contact. H. A. Curtis, chief of the research and development department, is chairman of the committee; W. B. Ross, its secretary, is spokesman for the laboratories at the company's New York headquarters. Contact with the board of directors is through H. F. Abrams, one of the board members representing the manufacturing department.

Newly Constructed Facilities

To correspond with the new laboratories' staff of 140 men, the research plant has been increased threefold in size. It now comprises four main buildings, all designed by the company's engineers, and situated on spacious, well-planted grounds. Of these, two house the chemical and physical laboratories, library and administration, while the two others—of long, one-story construction—are devoted to chemical and mechanical engineering. The former, at the head of the research site, are built of brick, while the latter, extending out to the rear, are of brick and concrete construction.

The mechanical engineering building is dedicated largely to the automotive work. Designed for actual service tests on petroleum products, it accommodates seven dynamometer and cold rooms, insulated for temperature and sound, five knock-testing chambers, and sundry smaller installations. It includes facilities for service tests on the largest motor trucks, a large refrigeration plant, a photographic chamber, and a set of offices. Company motor cars engaged in road tests use the laboratory as testing stations.

Chemical Engineering Experiment

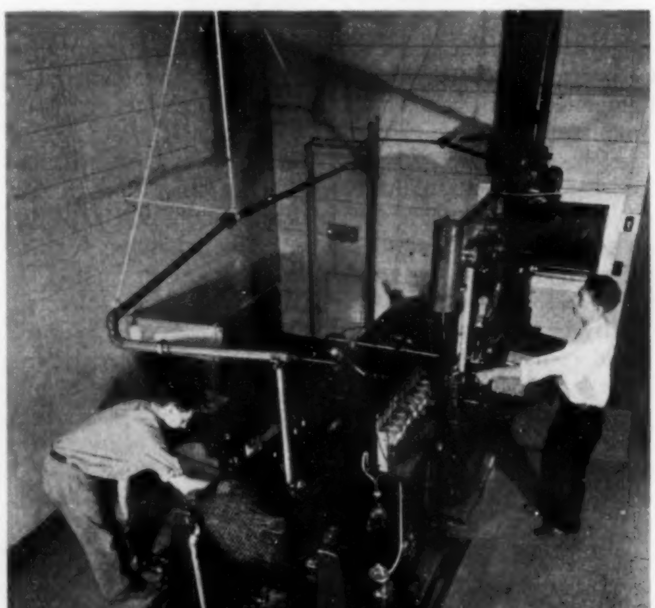
Chemical experiment originates, and in the case of analyses stays, in the chemical and physical laboratory buildings. Built of brick, with interior walls of ceramic tile, they are equipped with special attention to durability and flexibility of apparatus. Process research has its beginnings here and, if proved feasible, is then transferred to the chemical engineering building.

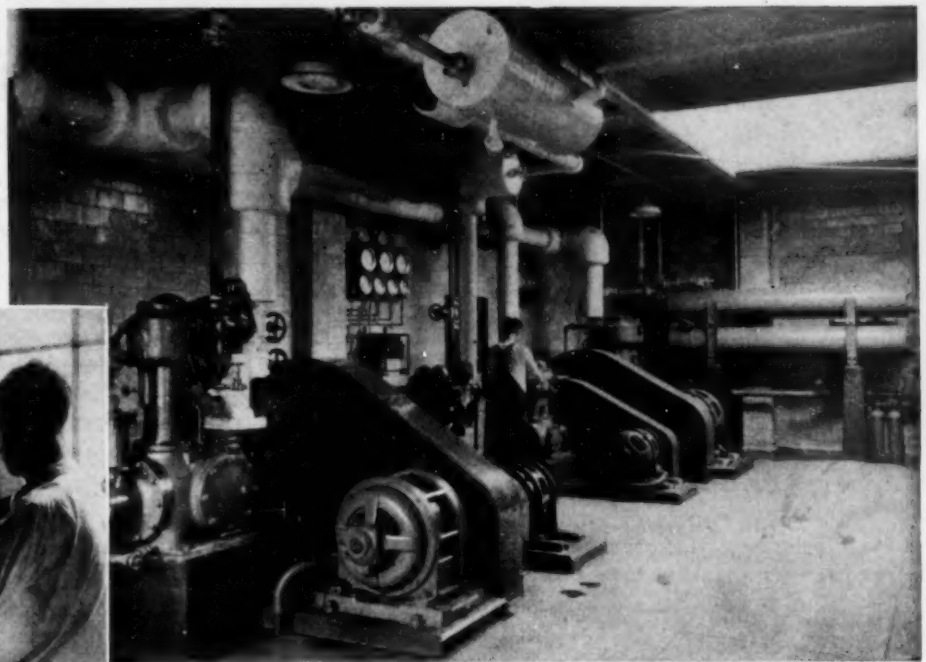
By its nature, the chemical engineering section is in constant change. Processes progress through refinement; auxiliary experiment is developed; and new projects are brought in. Therefore the building is laid out in spacious halls, with a few offices and lecture hall at one end. High-pressure work is segregated outside, but controlled from within. The only permanent installation is the small-scale refinery equipment for batch production of required materials. Consequently the building is especially arranged to accommodate any feasible process from its laboratory infancy up to the semi-commercial stage.

Emphasis is on fundamental engineering work entailing the unit operations, and only when it has been applied to the perfection of all operating details in a given process does the latter leave the laboratory for the refinery. Here it is installed in full size by the plant's personnel with the assistance of the research engineers responsible for it.

Suggestions and projects for research emanate from any department of the company, through the research committee, but from the moment of acceptance, the work progresses in its own responsible domain. Thus the forces, which nowadays can alone promise a reasonable industrial existence have been at once re-created and liberated for performance.

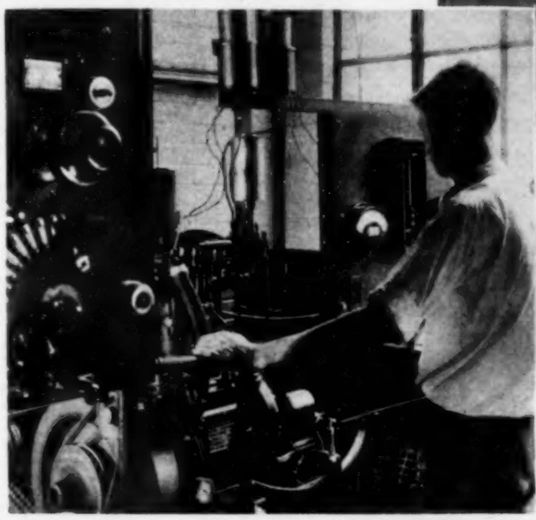
Insulated Dynamometer Room in Mechanical Engineering Building

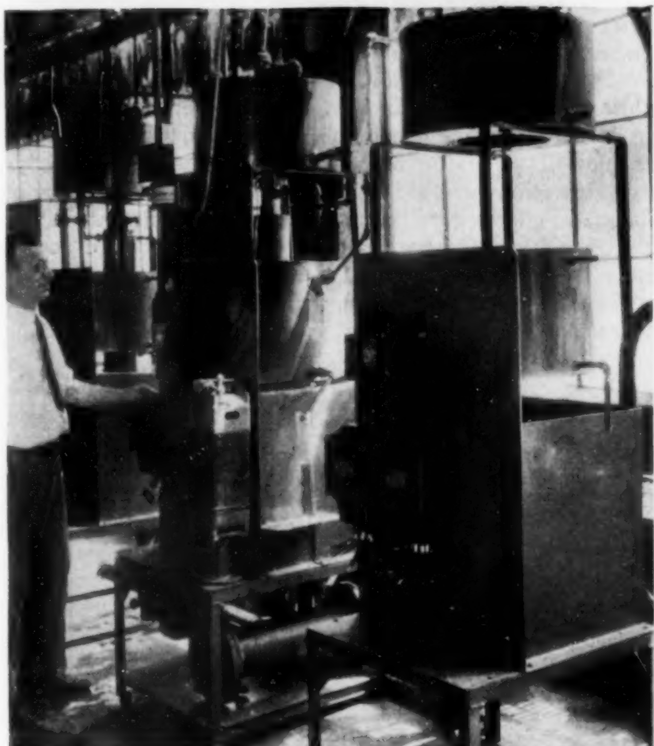




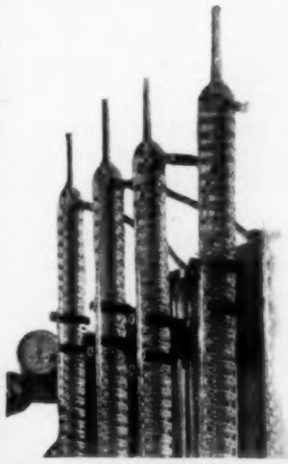
Above—Refrigeration Plant Serving Laboratories and Low-Temperature Automotive Tests

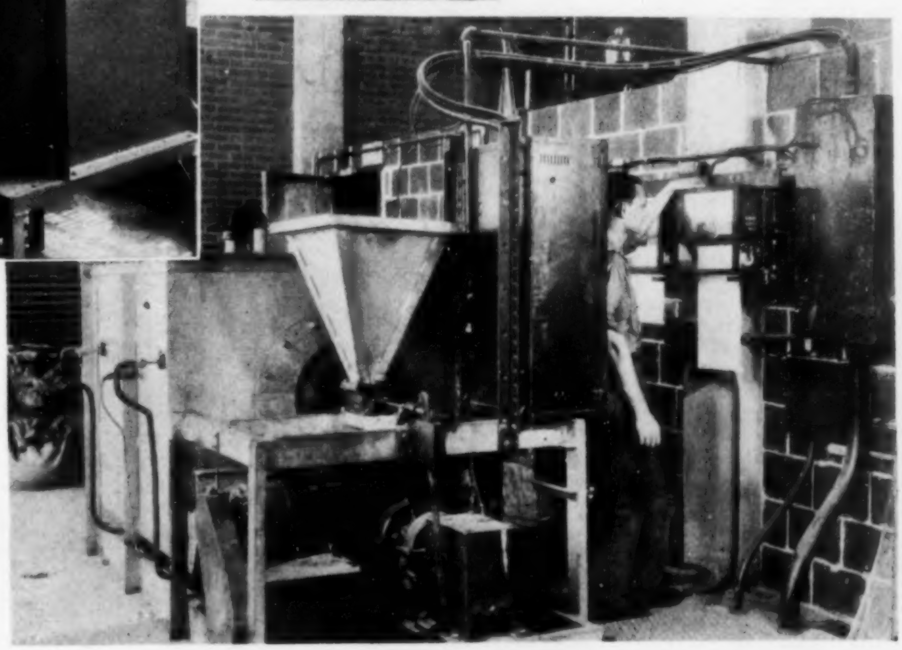
Below — One of the Five Knock-Testing Devices in Operation





Three Experimental Stills in Chemical Engineering Building, One in Operation





Scene in Chemical Engineering Process Division, Showing Clay Burner

Graphical Determination of Ammonia Solubility

By D. S. DAVIS
Appleton Vocational School
Appleton, Wis.

SEVERAL EXPRESSIONS relating the equilibrium pressures of ammonia over aqueous ammonia solutions, the concentration of dissolved ammonia, and the temperature have been proposed. The equation:

$$p = \frac{a\,c}{b - c} \qquad (1)$$

where p is the partial pressure of ammonia in millimeters of mercury over a solution which has a concentration of c per cent ammonia and a and b are constants (Fig. 1) depending upon the temperature, was developed by Whitman (private communication, 1924) for use with Perman's data (*J.C.S.*, **83**, 1903, p. 1168).

From thermodynamic considerations Kowalke, Hougen, and Watson (*Chem. & Met.*, **32**, 1925, pp. 443, 704) derived the following equation:

$$\ln \frac{p}{m} = 10.82 - \frac{4{,}425}{T} \qquad (2)$$

where p is the partial pressure of ammonia in atmospheres over a solution containing m gram mols of ammonia per 1,000 grams of water at a temperature of T deg. C. abs.

In 1925 Sherwood (*Ind. Eng. Chem.*, **17**, 1925, p. 745) published a critical study of all the best ammonia data, presenting tables and charts of pressure, temperature, and solubility values. A little later (*Chem. & Met.*, **32**, 1925, p. 704) he proposed the following equation:

$$S = K p^{n} - 83 + 1.27\,t \qquad (3)$$

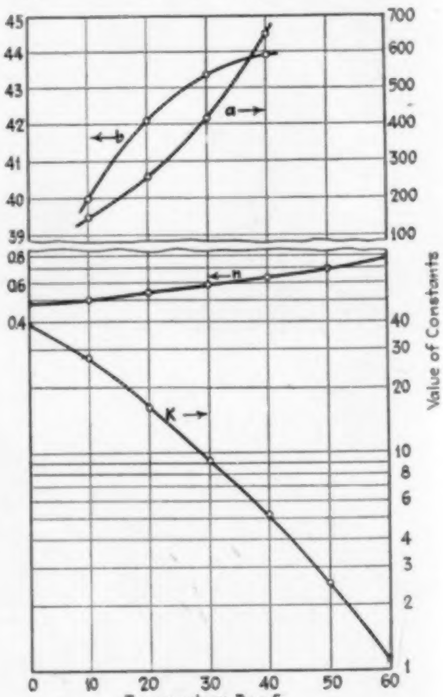
where p is the partial pressure of ammonia in millimeters of mercury over a solution of S grams of ammonia in 1,000 grams of water at a temperature of t deg. C. K and n are constants depending on the temperature and must be read, at considerable sacrifice of accuracy, from a plot, Fig. 1. No attempt was made to express K and n as functions of the temperature.

Equation 1 is limited to temperatures between 10 and 40 deg. C., and to concentrations below 13 molal and is not independent of the plot of a and b against the temperature. Equation 2, while satisfactory below molalities of 4, is based on the heat of solution of ammonia at 25 deg. C., and is restricted to use near this temperature. Equation 3 must be supplemented by the plot of K and n against t and shows some fairly large deviations from the accepted values. Sherwood's tables and charts give pressures and solubilities at intervals of 10 deg. C., but are difficult to interpolate accurately. Hence there appears to be a need for an equation connecting these variables which can be used with accuracy over wide ranges.

Comparison of Actual Solubilities of NH_3 With Those Obtained by Calculation

Temp., Deg. C.	Partial Pressure NH_3 mm. Hg	S = gm. NH_3 per 1000 gm. H_2O (Sherwood)	Equations 4 and 5 S	Equations 4 and 5 Per Cent Dev.	Equation 3 S	Equation 3 Per Cent Dev.	Equation 2 S	Equation 2 Per Cent Dev.	Equation 1 S	Equation 1 Per Cent Dev.
0	947.0	1,000	1,003.8	0.4	964.0	−3.6	....	...	.....	...
	275.0	500	499.5	−0.1	495.0	−1.0	....	...	.....	...
	89.5	250	246.3	−1.5	254.5	1.8	....	...	.....	...
	11.2	50	49.8	−0.4	.....	...	....	...	.....	...
10	987.0	800	793.4	−0.8	794.2	−0.7	....	...	.....	...
	439.0	500	501.7	0.3	506.2	1.2	....	...	.....	...
	190.0	300	302.0	0.7	308.7	2.9	....	...	293.0	−2.3
	103.5	200	201.3	0.7	209.2	4.6	....	...	200.0	0.0
	41.8	100	99.1	−0.9	.....	...	....	...	98.3	−1.7
	11.3	30	30.0	0.0	.....	...	....	...	29.8	−0.7
20	945.0	600	596.8	−0.5	619.4	3.2	....	...	.....	...
	298.0	300	301.5	0.5	303.9	1.3	....	...	293.0	−2.3
	56.0	75	74.9	−0.1	.....	...	81.2	8.3	74.0	−1.3
	24.9	40	39.5	−1.3	.....	...	40.4	1.0	38.9	−2.8
	12.0	20	19.7	−1.5	.....	...	19.5	−2.5	19.3	−3.5
30	719.0	400	390.3	−2.4	466.1	1.5	....	...	.....	...
	260.0	200	205.9	3.0	202.5	1.3	....	...	201.0	0.5
	79.7	75	75.4	−0.5	.....	...	78.5	4.7	75.3	0.4
	29.6	30	30.2	0.7	.....	...	29.2	−2.7	29.8	−0.7
	11.5	12	12.1	0.8	.....	...	11.3	−5.8	11.9	−0.8
40	692.0	300	289.9	−3.4	287.5	−4.2	....	...	.....	...
	273.0	150	156.5	4.3	145.8	−2.8	....	...	150.0	0.0
	120.0	75	74.3	−0.9	73.8	−1.6	....	...	73.8	−1.6
	45.0	30	30.0	0.0	.....	...	....	...	29.4	−2.0
	15.4	10	10.6	6.0	.....	...	....	...	10.3	3.0
50	825.0	250	245.5	−1.8	242.1	−3.2	....	...	.....	...
	405.0	150	152.3	1.5	140.5	−6.3	....	...	.....	...
	91.1	46	40.2	0.5	37.7	−5.8	....	...	.....	...
	22.2	10	10.3	3.0	.....	...	....	...	.....	...
60	834.0	200	.....	...	190.2	−4.9	....	...	.....	...
	361.0	100	.....	...	96.5	−3.5	....	...	.....	...
	94.3	30	.....	...	30.0	0.0	....	...	.....	...

Fig. 1—Constants for Equations 1 and 3



For the ammonia data as compiled by Sherwood the following two equations are proposed:

$$S = \frac{p}{0.0015\,p + 6.989\,(100 + t)^{5.7369} \times 10^{-13}} \qquad (4)$$

for values of S below 100; and

$$S = (e^{-0.02512t+3.542} + 1)\sqrt{p} - 100 \sinh^{-1} \tan\,[-21.844 \log\,(t + 25) + 76.264] \qquad (5)$$

for values of S above 100. These equations cover partial pressures, p, up to 1,000 mm. of mercury and temperatures, t, from 0 to 50 deg. C., S indicating grams of ammonia per 1,000 grams of water. Equations 4 and 5 are not intended for ordinary use, since routine calculations may be handled with greater facility by means of the nomographs, Figs. 2 and 3, from which solubilities may be read either on the basis of 1,000 grams of water or 1,000 grams of solution. The solubility, σ, on the latter basis is related to S by the expression:

$$\sigma = \frac{S}{1{,}000 + S} \qquad (6)$$

The tabulation on p. 576 lists a comparison of actual solubilities with solubilities calculated by the five equations, together with a comparison of percentage deviations. The table covers only four or five pressure-solubility combinations at each temperature.

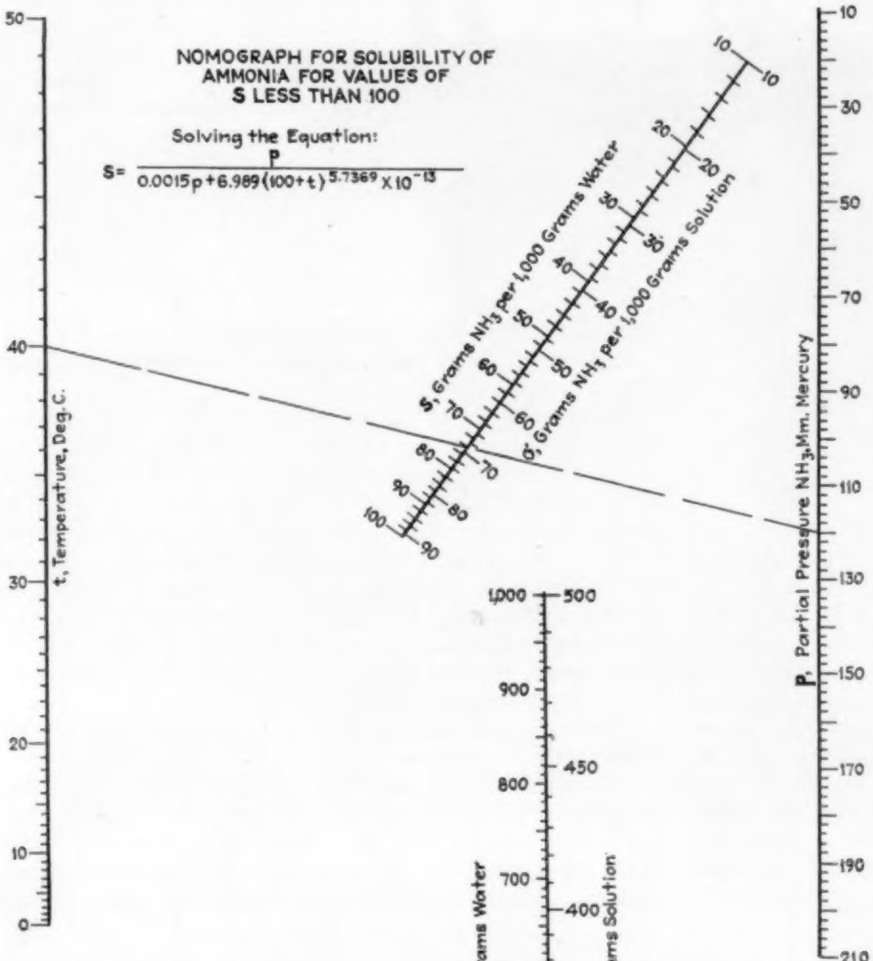


Fig. 3—(Below) Used for Determining Grams of Ammonia per 1,000 Grams of Water or of Solution, Where S Is More Than 100

To determine either the partial pressure of ammonia over a solution containing more than 100 grams NH_3 per 1,000 grams of water, or, knowing the partial pressure, to determine ammonia concentration in the solution, connect the temperature of the solution by straight-edge with the known quantity, reading the unknown on the straight line so formed, or on its prolongation. For example, for a temperature of 10 deg. C. and a concentration of 600 grams NH_3 per 1,000 grams of water, the partial pressure of ammonia over the solution is found to be 600 mm. of mercury.

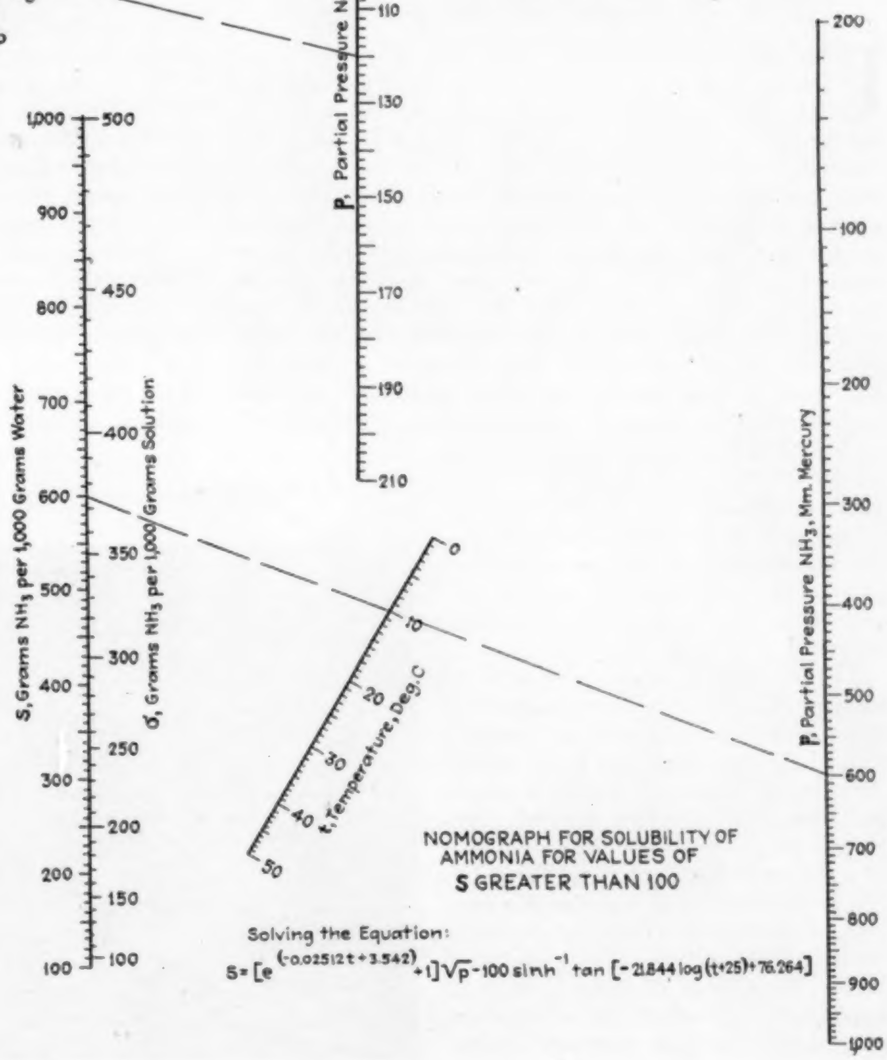
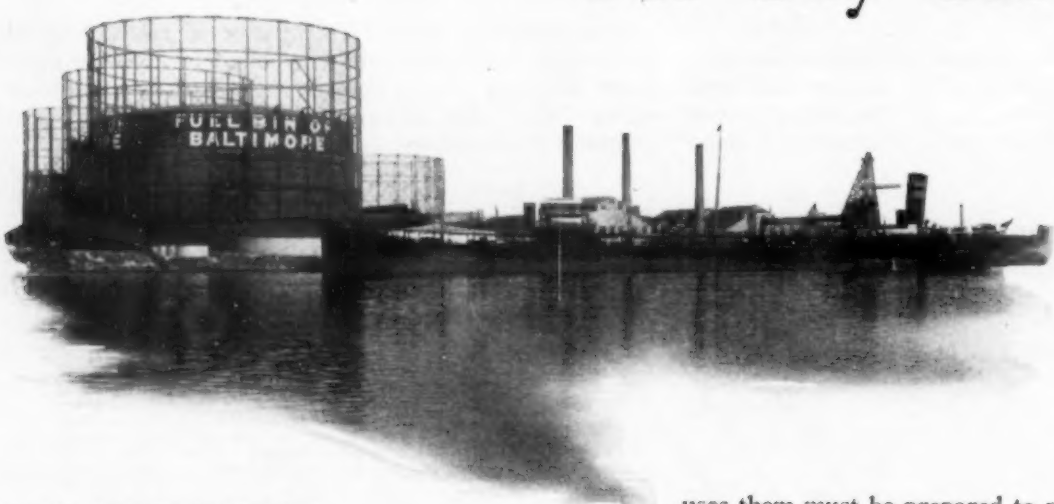


Fig. 2—(Above) Used for Determining Grams of Ammonia per 1,000 Grams of Water or of Solution, Where S Is Less Than 100

To determine either the partial pressure of ammonia over a solution containing less than 100 grams NH_3 per 1,000 grams of water, or, knowing the partial pressure, to determine the ammonia concentration in the solution, connect the temperature of the solution by straight-edge with the known quantity, reading the unknow on the straight line so formed, or on its prolongation. For example, for a temperature of 40 deg. C. and a partial pressure of 120 mm., S = 74 grams of ammonia per 1,000 grams of water, and σ = 69 grams of ammonia per 1,000 grams of solution.

MIXING FUEL GASES

For City Gas Supply



Spring Gardens Station of the Consolidated Gas Electric Light & Power Co., Baltimore

By JOHN H. WOLFE

Superintendent
Consolidated Gas Electric Light & Power Co., Baltimore, Md.

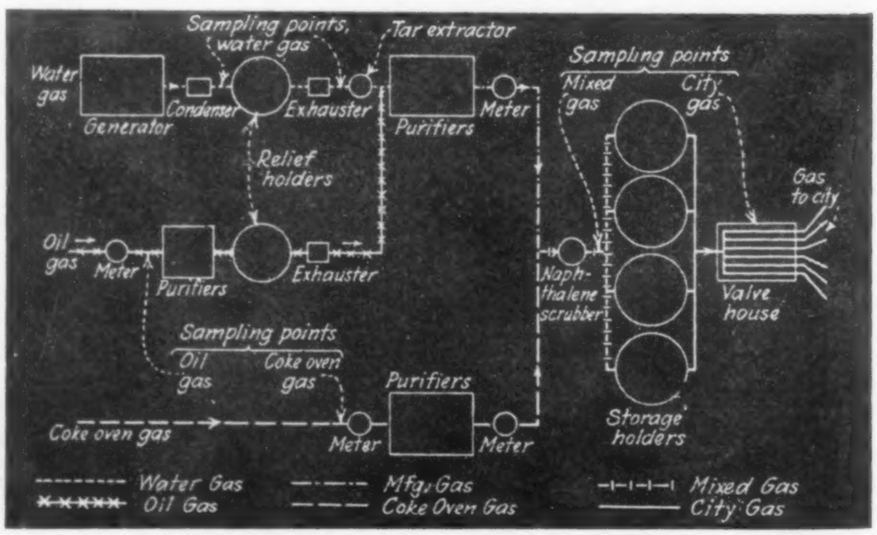
UNLESS they have been brought into close contact with the inner workings of modern city gas plants, chemical engineers and chemists are likely to join the layman in accepting as a matter of course the highly technical service which is rendered by these utilities. One has but to open a valve or turn a cock and the service is available, abundant in quantity, and uniform in quality. Since all necessary planning and effort have already been put forth by the utility, nothing remains for the consumer but to make the best use of his gas supply. He need never trouble himself over questions of continuity of service and uniformity of product, for the modern gas utility has fully provided for and assured their attainment. Nevertheless, an insight into some of the gas companies' problems should be of interest to chemical engineers in general, for similar problems may apply to their own manufacturing operations. A further cause for interest lies in the newer sources of supply which are now being offered to many gas companies.

Within recent years, the proper mixing of two or more combustible gases has received the closest attention of the gas industry. In the early days, more than one hundred years ago, no such problem existed, for only coal gas was available. Today at least seven kinds of gas (Table I) are being used to a considerable extent, separately or combined in mixtures, and others are entering the picture. Since some of these gases are byproducts of other manufacturing operations, the gas company which uses them must be prepared to provide coverage for any and all deficiencies and variations in a supply which is beyond its immediate control.

Furthermore, the gas company must be able to purchase byproduct gases at prices which will permit it to secure the quantity markets so necessary for both the gas company and the vendor of the byproduct gas. The latter rarely appreciates the important part that price plays in the expansion of city gas consumption. More than a little of the gas company's effort must be expended in bringing the byproduct gas manufacturer to the realization that gas costs must be low in order mutually to serve the city gas consumer, the utility, and the byproduct gas manufacturer.

Understanding of the present sources of gas supply necessitates a glimpse into the history of gas manufacture. Coal gas, produced in retorts, which was the earliest development, retained its position of dominance for many years with only rather unimportant inroads from gases made by the destructive distillation of wood and oil. Much of the early supremacy of coal gas has

Path of the Various Gases Through the Spring Gardens Plant

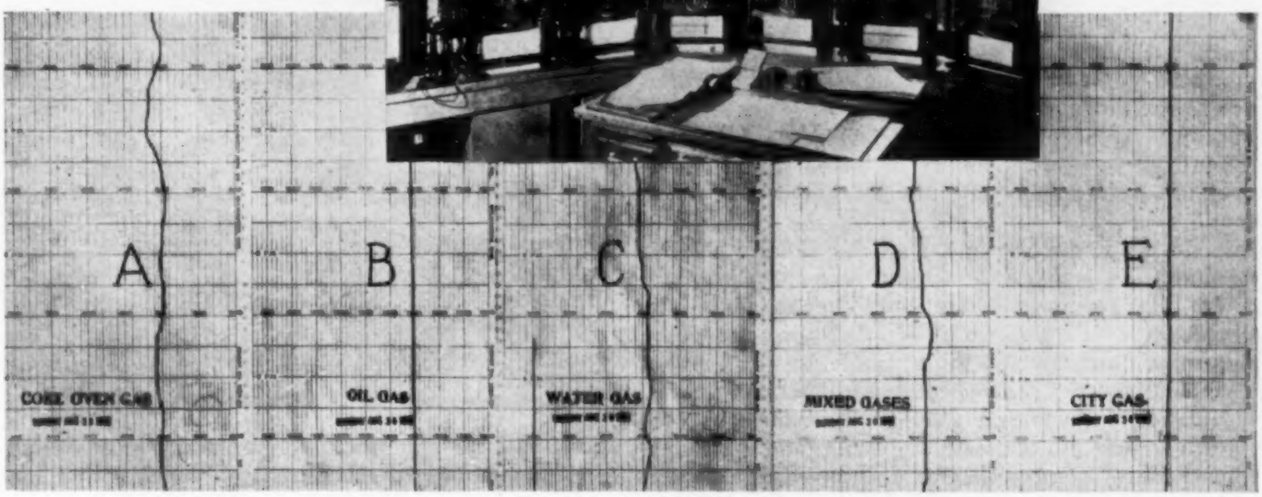


returned in more recent times through the advent of the byproduct coke oven.

About 1873-74, the carbureted-water-gas process was developed which utilized both the reaction of steam with incandescent carbon and the cracking of oil vapors to produce a combustible gas. The process was found to have wide application and it supplies, together with the coke oven, the bulk of our present day manufactured-gas production. Each method has its distinct advantages. The simultaneous use of both, with proper mixing of the product, is often of great economic value, since the two are, in a sense, complementary. Although capital charges are high with the coke oven, they are low with the carbureted-water-gas set. Against this we have the somewhat lower material and labor charge for operating the byproduct coke oven. Whereas the oven produces coke to compete with the city gas as a fuel, the water-gas set may use coke as its raw material. Definitely to the advantage of the water-gas set is its far greater flexibility as regards both capacity and operation. Not only can the water-gas set make gas which ranges in character from producer gas, through blue gas, to carbureted water gas, but it can be put into or taken out of service, without damage, in extremely short order.

Recently other gases have come into the market. Natural gas, after several flurries in the last century, is endeavoring to gain the center of the stage. Butane and propane from natural gasoline plants and oil gas from oil refineries are being offered both for standby and continuous mixing service. This diversity of gases has enormously broadened the opportunities of the gas utility, but at the same time it has made demands on mixing technique which were unthought of not many years ago. When mixing was first practiced, little regard was given to proportions, for the importance of controlled quality was not clearly recognized. But complaints of poor service began to come in, and the industry found it must undertake a study of gas-burning appliances in order to determine the causes for the poor performance. This was carried on both by the American Gas Association and by individual companies, and resulted in certain improvements in the appliances themselves, but, more important still, it emphasized the need for strict uniformity of heating value, specific gravity, and combustion characteristics in the gas provided for city supply.

Accurate control of heating value has long been known to be of great importance. The standard value set for city gas in different communities depends to some extent on local circumstances of manufacture or supply, and ranges from 400 to 1,150 B.t.u. per cubic foot, with the most usually accepted values within the range of 500 to 565 B.t.u. This requirement of uniformity is in most cases fixed by order of a state commission, a procedure in which the utilities readily concur, since they realize its importance. Much money has been spent by the gas companies in the development and purchase of the best possible control apparatus, and automatic equipment is now available to carry out the regulation of heating

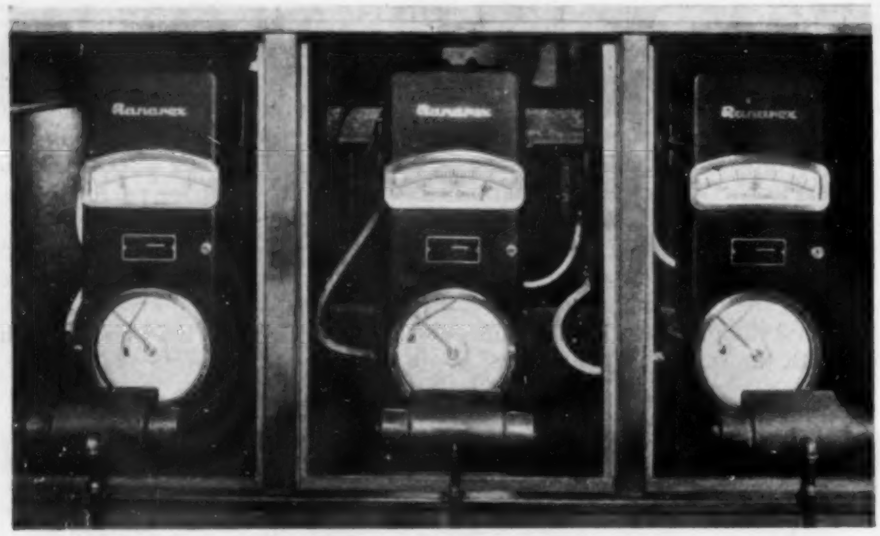


Left, Control Room and Recorders for Calorimeters Which Measure Heating Value of Constituent and Mixed Gases; Below Are Typical Heating-Value Records of Gases Before and After Mixing, and Leaving Holders; Note Uniformity of Final Gas, *E*

Table I—Composition of Fuel Gases Used Separately or Combined in Mixtures

Gas	B.t.u. per Cu.Ft.	Per Cent CO_2	Illuminants	O_2	CO	CH_4	H_2	N_2	C_2H_6	C_3H_8	C_4H_{10}	Source or Authority
Coal Gas	634	1.1	6.6	0	9.0	34.0	47.0	2.3	....	....	...	Haslam and Russell
Coke-Oven Gas	507	2.2	2.3	0.5	8.8	27.3	48.9	10.0	....	....	...	Baltimore
Refinery Oil Gas	1,550	0.5	[1]	0.6	0.1	35.8	3.7	5.5	24.6	13.7	4.3	Baltimore
Natural Gas	1,100	0.1	[2]	0	0	88.9	0	0	9.5	0.1	0.6	West Virginia
Carbureted Water Gas	486	4.9	6.6	0.2	32.9	11.5	35.7	8.2	....	....	...	Baltimore
Blue Water Gas	302	3.5	0	0.6	43.5	0.7	47.3	4.4	....	....	...	Morgan
Producer Gas	136	5.7	0.4	0	22.0	2.6	10.5	58.8	....	....	...	Haslam and Russe

[1] C_2H_4, 0.9 per cent; C_3H_6, 10.3 per cent. [2] C_2H_4, 0.4 per cent; C_3H_6, 0.4 per cent.



Ranarex Recorders for Measuring and Recording Specific Gravity of Constituent and Mixed Gases; Reading From Left, They Record Coke-Oven, Manufactured, and Mixed Gases

value, provided that the conditions imposed are not too severe.

The effect of specific gravity variations was not so thoroughly understood in the early days. It is well known that the flow of gas through an orifice varies inversely as the square root of the specific gravity. Since the flow of gas to a burner is controlled by an orifice which injects a definite quantity of gas at a given pressure, changes in specific gravity will result in flow variation and non-proportional changes in the quantity of entrained air. Reduction in the specific gravity below a certain limit yields too little air and incomplete combustion; too high a gravity brings about over-oxidation and flashing back.

The third factor, combustion characteristics, is one which is not always readily controlled, nor determined by calculation from known values. It depends on both the heating value and the specific gravity, and even more on the chemical composition of the gas. It embraces burning rate, which varies widely from gas to gas, as is shown in Table II. Methane and ethane, for example, are slow-burning; hydrogen, fast-burning. For the gas-air mixtures giving the most rapid flame propagation, as determined under comparable conditions in 1-in. tubes, rates in various gases are as follows: methane, 2.2 ft. per second; producer gas, 2.4; ethane, 2.8; carbon monoxide, 4.1; coal gas, 5.2; and hydrogen, 15.9.

Thus it becomes evident that the utility which would satisfactorily serve its customers must maintain all of these factors under close control. Where the city gas is a mixture, the problem becomes all the more difficult. This will appear from a description of the operations in the gas manufacturing department of the Consolidated Gas Electric tric Light & Power Co., of Baltimore, which is given here to illustrate one solution of the mixing problem.

At present, the city gas in Baltimore and vicinity is composed of a mixture, in varying proportions, of three separate supplies: byproduct coke-oven gas, oil-refinery byproduct gas, and a manufactured gas which is produced at the Spring Gardens plant of the company. This last must not only be able to meet the entire demand in the event of failure of the byproduct supplies but it must also compensate for all variations in quality and quantity of the latter. By proper control of the manufactured gas, the Baltimore plant is able to meet the state requirement and deliver continuously a gas having a monthly B.t.u. average of 500, with an allowable maximum, average fluctuation of only 10 B.t.u. below or 20 B.t.u. above this value for any individual reading.

In order to secure this uniformity and to control the gravity between 0.55 and 0.63 (air = 1), the plant carefully meters the various gases and uses many instruments for recording both heating value and gravity of the three supply gases, of the mixed product, and of the city gas as delivered from the holders. The heating value is measured and recorded by Thomas calorimeters, and gravity by Ranarex recorders. Well-trained men frequently and systematically check these instruments against standards so that they may accurately serve in controlling the output and quality of the manufactured gas, which must compensate for fluctuations in the purchased supplies and in daily consumption requirements.

Table II—Maximum Combustion Speeds of Gas-Air Mixtures

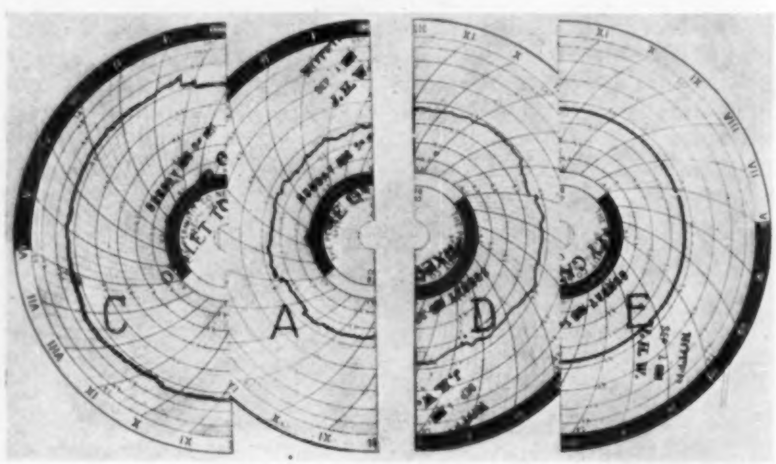
(Determined in 1-in. diameter, air-cooled tubes)

Gas	Maximum Combustion Speed*, Feet per Second	Gas Content of Maximum-Speed Gas-Air Mixtures Per Cent
Hydrogen	15.9	38.5
Carbon monoxide	4.1	50.0
Methane	2.2	9.9
Ethane	2.8	6.3
Ethylene	4.7	7.1
Equal parts O_2 and H_2	10.3	44.0
Coal gas	5.2	17.0
Producer gas	2.4	51.0

*Speed in maximum-speed gas-air mixture.

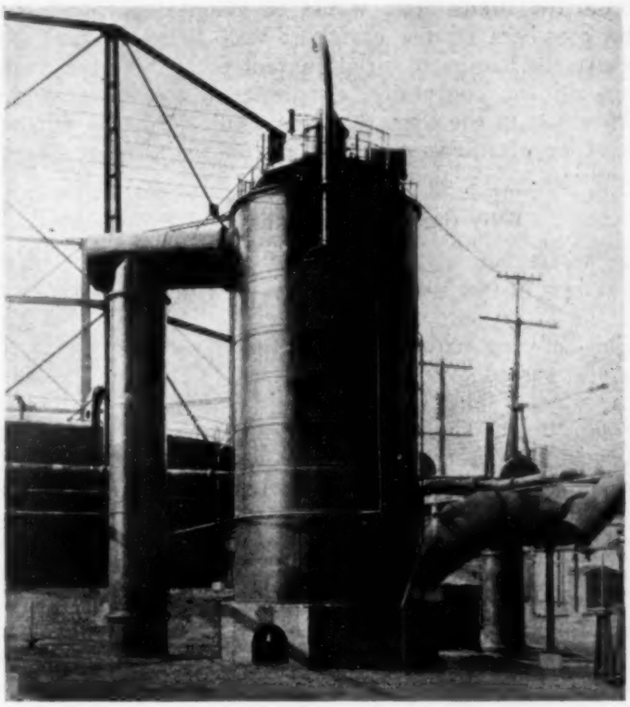
Byproduct coke-oven gas is purchased from a local steel company, which pumps the gas through a 13-mile

Typical Specific Gravity Records From Instruments Shown Above; They Represent; *A*, Coke-Oven Gas; *C*, Manufactured Gas; *D*, Mixed Gas Before Holders; *E*, Mixed Gas Leaving Holders; Note Uniformity of *E*



pipe line to the gas plant after tar, ammonia, and benzol have been removed. Because of load conditions encountered by the steel company, both volume and quality of the gas vary considerably. Under normal conditions, the volume fluctuates between 600,000 and 800,000 cu.ft. per hour, the heating value between 480 and 530 B.t.u. per cubic foot, and specific gravity between 0.37 and 0.45. The gas received by the gas company is passed through purifiers to remove sulphur compounds, after which it is mixed with the other components.

A local oil refinery supplies the oil gas, which is delivered through a 5-mile pipe line. Under normal operating conditions, the supply range from 90,000 to 120,000 cu.ft. per hour, while the B.t.u. varies between 1,500 and



Feld Scrubber for Naphthalene Removal and Final Mixing of Constituent Gases

1,550 and the specific gravity between 0.95 and 1.0. This gas likewise is treated for removal of sulphur compounds before it is mixed with the product of the water-gas generators.

The water-gas plant is, of course, the balance wheel of the entire set-up. It has to be capable of supplying all or any part of an average daily send-out ranging from 23,000,000 cu.ft. in summer to 47,000,000 cu.ft. in winter, all of which must conform to the standards of quality previously cited. For this purpose we have 20 Lowe three-shell carbureted-water-gas sets of standard design, from which gas ranging in B.t.u. from 125 to 600, and in specific gravity from 0.63 to 0.90, may be obtained. Values between 300 and 600 B.t.u. are produced by carbureting blue water gas, while values between 125 and 300 B.t.u. are obtained by mixing suitable proportions of blue (uncarbureted) water gas and generator (producer) gas. These latter values are made by operating the generators somewhat similarly to gas producers, that is, by diluting the uncarbureted gas, made on the "run" or steaming cycle, with the generator gas, which is made on the "blasting" cycle.

This type of equipment furnishes the degree of flexibility so necessary under the conditions imposed at Baltimore. A further and even greater advantage, economically, is that sufficient equipment may be held in reserve at low capital cost to meet every possible contingency.

Even as originally perfected, the carbureted-water-gas process had a high inherent flexibility. In this process, oil is introduced into the second shell of the set, the "carburetor," during the "run," or gas-making portion of the cycle. Here and in the "superheater," at an operating temperature of about 1,500 deg. F., the vaporized oil is cracked to form a permanent gas by contact with the incandescent checker brick with which these shells are packed. This oil gas mixes intimately with the blue gas which is issuing from the generator. The carbon and tar formed in the cracking are then removed from the gas in the proper scrubbing, condensing, and tar-removing equipment. Control of the heating value of the resultant gas is obtained by varying the quantity of oil injected; and adjustment of the specific gravity, by suitable changes in the cycle of operations.

More recently, what is called the "low-gravity water-gas process" has been developed to permit formation of a gas containing a high percentage of hydrogen. Here the oil is introduced into the generator, and is cracked in contact with the incandescent generator fuel. The considerable quantity of carbon formed is consumed partly as fuel in the "blow" (air-blasting) portion of the cycle and partly in the blue-water-gas reaction during the "run" (steaming). The same sort of procedure may be followed with high-gravity gases, such as natural and refinery oil gas, in which case the process is known as "reforming." This yields lighter hydrocarbon gases, as well as hydrogen and carbon, the latter being consumed during the blow and run as noted above. Provided heavy gases are available in large quantities, and at low cost, the process is very useful, particularly when the objective is the mixing of the product with lighter supplies of gas.

Through the use of these processes, we are able to manufacture gas which will completely compensate for the variations in the purchased supplies. After the latter have been partially purified, they are added to the manufactured gas, as is shown in the flow sheet, and put through the final purifiers, where preliminary mixing is accomplished. Passage through a Feld scrubber completes the mixing and reduces the naphthalene content to a point where none will crystallize in the distribution system. After leaving the scrubber, the gas enters the storage holders, where final equalization of small fluctuations in the heating value and gravity takes place. The result is an astonishing degree of uniformity, as is attested by the recorder charts reproduced here. Although these charts show only a short interval, this uniformity is maintained at all times.

It is to be hoped that this brief discussion will have brought to the technically minded reader some realization of the problems which confront the gas utility, as well as a recognition of the careful planning and constant watchfulness that are the responsibility of the gas industry. Regardless of circumstances, the gas company must be prepared to meet the demand. A "force majeure" clause in the contracts on which the byproduct gases are purchased may absolve the vendors in the event of strikes, insurrections, and "acts of God," but even if its purchased gas supplies are not delivered, the gas company must "carry on," to the end that city gas may continue to merit its reputation as the cleanest, most easily controlled, and most reliable of fuels.

World Nitrogen Situation

—a German Viewpoint

Editor's Note—*The Frankfurter Zeitung of Aug. 20, 1931, publishes a thoughtful and extremely comprehensive study of the problems presented by the world surplus of nitrogen products. It includes not only the need for better balancing of production and consumption but also an account of the weakened price structure and the reasons underlying the recent failure of the International Nitrogen Cartel. Pertinent excerpts from a translation of the entire article, which is available in Chem. & Met.'s editorial offices, are reprinted on this page.*

THE development of the world nitrogen industry has been characterized by overexpansion of certain branches and this has been strikingly emphasized in the present industrial depression. Before the War the nitrogen production of the world amounted to about 770,000 tons, of which 60 per cent was the natural Chilean product; only Germany and England had significant synthetic production. In 1925 the world production had increased to 1,250,000 tons of pure nitrogen and in 1930 this amounted to 2,180,000 tons. Ever since 1928 the slowly advancing consumption has fallen behind the productive capacity. Warehouses began to fill up—first those of the Chilean industry and later, in spite of price reduction, the warehouses of the synthetic industry. In 1930 about 40 per cent of the year's production went into the warehouse. At the present time stocks in Germany amount to more than 300,000 tons of nitrogen; those in Chile contain more than 400,000 tons. If one considers that the stocks in other countries also have grown and that the consumption for the present year will not exceed an estimated 1,200,000 tons, it will readily be seen that almost the entire world requirements for the coming year are already covered by stocks in warehouses. In the meantime, however, the capacity has grown to almost 4,000,000 tons per year, of which 30 per cent is in Germany, 15 per cent in the United States, 13 per cent in Chile, 7 per cent each in France and Japan, 6 per cent in England, 5 per cent in Belgium, and from 2 to 3 per cent each in Russia, Norway, Poland, Holland, and Italy. The Canadian contribution and that of Czechoslovakia are each under 2 per cent.

This situation is of serious concern, particularly for Germany, which alone is in the present position of being able to supply the present world consumption and whose nitrogen industry today is operating at only about 20 to 30 per cent of its capacity.

The failure of the negotiations for prolonging the International Nitrogen Cartel has resulted in a price war with enormous loss at a particularly inopportune time and clearly shows the weakness of the political direction which failed without attempting to buy peace through concession. The opposition to the German-Norwegian-English group was expressed more and more openly in the negotiations of the last year. At the conclusion of their agreement with Chile in 1929 there was no complete understanding, because, inside the synthetic industry, there was considerable skepticism over the future of Chile even after the introduction of the Guggenheim process and the Chileans' cost figures had been presented.

Recent developments have shown that this view was correct, in so far as a reorganization of the Chilean industry occasioned large financial requirements and, more recently, other financial difficulties which did not yield the commercial earnings that had originally been advanced on the basis of purely technical information.

The goal was a limitation of production and a stabilization of price, apparently in the interest of Chile. For the Europeans a maximum production of 1,110,000 tons of nitrogen was fixed and an equalization fund was created for the payment of damages to any producer who would voluntarily limit his production. To this fund Chile was to contribute 15,000,000 marks, but at the same time was not required to reduce production. Chile also won a certain freedom of market at the expense of the synthetic producers against cash payment. From the funds there would be material payments for the members of the cartel as well as to France. In return the European cartel guaranteed to the other members of the convention export quotas with territorial protection in the hope that this would lead to a further decrease of nitrogen production on the part of export countries.

Why the International Cartel Failed

The fundamental weakness of the cartel arrangement is shown in two places and they have made the renewal of the cartel impossible this year. The fact that the fight between natural and synthetic nitrates was artificially passed over instead of being settled at the start showed the false tactics. The freedom of production brought to the Chileans no advantage. Their total quota allowed during the convention year was only 250,000 tons of nitrogen, while their stocks were greatly increasing. On the American market the Chilean quota has rapidly decreased from 151,000 tons of nitrogen in 1928-29 to 65,000 tons. It is readily understandable why the Chileans under these conditions declined the conditions set up by the synthetic industry to hold to *status quo,* and in turn asked for a fixed contingent of 360,000 tons with cancellation of any price advantage for synthetic nitrate. It is also quite as understandable that the synthetic industry could not meet these conditions. The logic of the developments won, which in this case means a stringing out of the long postponed struggle.

It is possible that the price war will call for a complete study of the basic principles and that then a renewal of the cartel can be brought about on a more secure basis. It is certain that one must consider the purchase and closing down of uneconomic plants, both domestic and foreign, a project for which the International Company for Nitrogen Industry, incorporated in Basel, was founded to carry out. The question of consumption requirements is certainly not yet fully solved. The meeting of the demands of the Asiatic and foreign territories for nitrogen fertilizer seems to have been more than was expected several years ago. The overproduction of agricultural products is another factor that will stand in the way of a further expansion of production for some years to come.

Also the enormous increase of American production which is now in second place and will continue to expand, and that of the Japanese, who already supply their inland requirements, must be considered. Even if one counts on an increasing nitrogen consumption in the distant future, there are still many difficulties which will be overcome only by a strong and completely reorganized industry.

Systematic Study Develops New Resin Molding Compound

By A. M. HOWALD

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EARLY in 1931, Toledo Synthetic Products, Inc., of Toledo, Ohio, began the commercial production of "Plaskon," a new urea-base compound for hot-molding. The research that created this product and the subsequent technical development of the results were carried out at Mellon Institute on a series of multiple industrial fellowships sustained by The Toledo Scale Co.

This company, in its efforts to improve the design and performance of the various types of scales manufactured by it, had encountered limitations imposed by available materials, none of which combined the desired qualities of strength, light weight, whiteness or light colors, and, for some applications, transparency. Actual experimental work followed only a thorough study of the then commercially available materials, as well as of those materials known to be in advanced stages of subcommercial development. While it has been possible to make some application of both aluminum and phenolic molding compounds to scale construction, with consequent decreases in weight, none of the available materials showed promise of meeting the other exacting specifications originally imposed by the fellowship donor.

Of the plastics considered, cellulose acetate was rejected because of its tendency to cold flow and distortion when warm, while ester and casein plastics were too slow and difficult of fabrication in large or intricate shapes. Then, too, hardened casein had prohibitive distortion with humidity and temperature changes.

The necessity for research exploration and development being apparent, therefore, two fields were thought to offer reasonable promise of a successful outcome: namely, light alloys with suitable white or porcelain-like finishes and synthetic plastics. A start was made with phenolic resin in its colorless modifications, but it was soon decided to confine the investigations to the more promising field of nitrogen-bearing synthetic resins, typified by urea-formaldehyde condensates.

Urea-Formaldehyde in the Past

Amorphous, gummy, or resinous condensation derivatives of urea with formaldehyde were described as early as 1897 by Goldschmidt (*Ber.*, 29, 2438, 1896; *Chem.-Ztg.*, 21, 460, 1897) and in 1908 by Einhorn and Hamburger (*Ber.*, 41, 24, 1908). Working prior to the age of interest in synthetic plastics, these investigators probably were less desirous of preparing infusible amorphous substances than of making more simple, crystallizable derivatives which they could purify.

John seems to have been the first to foresee the commercial possibilities of the glassy gelled products and purposely to prepare them (U. S. P. 1,355,834, 1920). He emphasized condensation without "catalysts" and in his application he described his products as being useful as glue, rubber, and glass substitutes. Following John, numerous patentees have described alleged improvements on his methods. As John had disclaimed the use of "catalysts," subsequent patentees usually feature them. Since John's invention, in fact, the patent record of urea-formaldehyde condensation has become a maze of claims and counterclaims representing numerous patentees and from which, commercially speaking, three plastics for hot-molding based on the ureas have emerged in this country. These differ widely among themselves and from other plastics in chemical and physical composition and in technique of molding.

When laboratory study was started on the urea-formaldehyde reactions at Mellon Institute, no urea plastic for hot-molding was available. Cast urea plastics, however, were being produced in Europe which, while discouragingly lacking in permanence and resistivity, were beautifully colorless and transparent.

Primary Investigations

In order to obtain preliminary ideas as to methods of attack, both in improving urea plastics and in making them moldable, cast products were prepared at Mellon Institute according to existing knowledge. These had the well-known weaknesses of high water absorption, cracking with weather changes or on exposure to light, and lack of uniformity. A few pieces accidentally made by the fellowship and some specimens obtained from others showed properties so far superior to those of the average sample that confidence in the fundamental soundness of the urea-formaldehyde reaction for the preparation of desirable plastics was established. A detailed literature and laboratory study was then made of all the reaction possibilities between urea and formaldehyde, whether crystalline or amorphous products were produced. As a conclusion from this investigation, it was decided that the usual weaknesses of the older urea-formaldehyde resins were not a necessary concomitant of their source but were due to certain preventable causes, as follows:

1. Uncombined reactants; namely, ureas, usually simple urea or thio-urea, and formaldehyde.
2. Crystalline and soluble byproducts from side reactions.
3. Incorrect ratios of reactants.
4. Incomplete conversion from the soluble to the insoluble form of condensate.
5. Mechanical strains arising from the evaporation of water or other solvent or of formaldehyde after finishing.

By continued systematic research covering several years, embracing particular attention to one or two of

these causative factors at a time and the testing of all products for hot and cold water absorption and with ultra-violet light, it was found possible to produce transparent or filled masses with water absorption as low as 0.05 per cent in 24 hours, unaffected by any exposure to ultraviolet light and resistant to boiling water on exposures up to one-half hour. Another line of investigation, carried on simultaneously, was a study of the conditions under which the resin could be formed by conventional methods of hot-pressing as applied to phenolic compounds.

After sufficient basic progress had been made on such a laboratory scale, a small pilot plant was built at Mellon Institute for the study of practical production and molding methods. This pilot plant gave invaluable experience and data for application later in the construction of a commercial unit.

Commercialization of Research

During 1930 it became apparent to the Toledo Scale Co., not only that "Plaskon" had many applications other than in scale fabrication, but that its manufacture, distribution, and further research development were highly specialized and could be better undertaken by a separate organization. Accordingly, the present Toledo Synthetic Products, Inc., was formed for this purpose. Then, after several months of installation of equipment and of plant production research, controlled by laboratory testing and cooperative practical molding, "Plaskon" molding compound was offered for other uses. Unlike many co-products of research, however, it is receiving successful and growing application for its original purpose, namely, in scale construction and housing.

"Plaskon" is produced commercially as either a granular or a very fine powder. Under the influences of heat and pressure, according to the usual practice of hot-molding, it first becomes plastic, then sets strong and rigid. The granular form is controlled in density and particle size to permit the easy production of preforms in standard machines, yet not to show signs in the finished molding of either granule or preform structure.

The bulk ratio between granular compound and finished molding is about 3 to 1, which is reduced to about 1½-1 in. preforms. A combination of properties, including rapid cure and a higher temperature resistance, permits molding "Plaskon" more nearly according to the technique applied to phenolic compounds than that followed for other translucent light-colored plastics.

The best steam pressure for molding will depend on the thickness of the section, mold design as influencing heat transfer and speed of ejection, depth of flow, available pressure, and other conditions. Thin shallow moldings of perhaps $\frac{3}{16}$ in. wall thickness or less, up to 2 in. in depth, may be advantageously molded at steam pressures of from 100 to 140 lb. Heavy moldings with wall sections of ½ in. or more give better results at lower steam pressures of from 60 to 100 lb. This lower range is also best even for thin moldings if the flow is deep—i.e., 4 in. or more—where there is danger of hardening before flow is completed. A higher steam pressure with correspondingly faster cure may be used even on heavy and deep moldings where slight cooling of the mold is practiced at the end of each cycle. Generally molding cycles for "Plaskon" may be expected to approximate those used for phenolic compounds.

The press pressure required will vary with various factors, but a range of 1 to 5 tons per sq.in. may be anticipated.

Influence of Curing

At temperatures between 250 and 350 deg. F., represented by steam pressures up to 180 lb.—mold temperatures equal to steam temperatures are seldom if ever obtained in practical molding—"Plaskon" hardens or cures with great rapidity. The degree of cure of a heat-reactive plastic may be measured through many properties, including hardness, strength, improvement in electrical properties, and resistance to solvents. In general, hardness and strength come early, while dielectric excellence and solvent resistance are attained relatively more slowly.

A comparison between phenolic and urea-type plastics, involving the degree of cure required, is afforded in the classes of solvents which affect them. In the case of phenolic resins ketone, ester, and aromatic solvents are representative; in the case of urea resins, water and nitrogenous solvents. In the attainment of resistance to reagents capable of dissolving the uncured resin, ordinary phenolic molding compounds are relatively slow; in the attainment of strength and hardness, they are fast. With urea-type resins the rapid attainment of solvent resistance is imperative, because of the prevalence of water, their best solvent. Practically complete non-absorption of water is obtainable in the cure of a good urea-type plastic, but this ideal is not ordinarily reached in practical molding—nor is it ordinarily necessary.

"Plaskon" has been made sufficiently reactive to obtain adequate water-resistance in from 20 seconds to 15 minutes, depending on the piece, the molding conditions, and the class of service expected. Strength and hardness are attained well within these limits, so that water-absorption becomes a measure of cure that is adequate for practical purposes. For ordinary uses, there should be no loss in surface finish of the molded product after 5 minutes' immersion in boiling water.

Properties of the Reacted Plastic

"Plaskon" combines infinite color possibilities with strength, light weight, and, of greatest importance, adaptability to mass fabrication. The base shade is one of neutral translucency, permitting pigmenting to give all colors. Its translucency varies from a light transmission of about 60 per cent through a $\frac{1}{16}$-in. section to complete opacity, as desired.

The following properties have been measured for fabricated "Plaskon." Where a range is indicated, this is due largely to variations in the degree of cure, the optimal values not being required in most cases.

Specific gravity	1.43.
Modulus of rupture	10,000 to 14,000 lb./sq.in.
Tensile strength	4,000 to 6,000 lb./sq.in.
Compressive strength	25,000 to 30,000 lb./sq.in.
Impact strength (Sharpe)	0.7 to 1.2 ft.lb.
Dielectric constant (25 deg. C.)	5 to 6.
Dielectric strength (puncture)	300 to 400 volts per mil.
Water absorption (20 deg. C.; ⅛-in. section)	0.07 to 0.66 per cent in 24 hr.
Resistance to solvents	Unaffected by alcohol, acetone, oil, or other common solvents.
Resistance to acids	Moderately resistant to cold dilute acids. Not resistant to hot or concentrated acids.
Resistance to alkalies	Quite resistant to cold dilute alkalis. Also resists hot, very dilute alkalis, such as soap, borax, cleaners, etc.
Hardness (Mohr scale)	3.0 to 3.5.
Hardness (scleroscope)	80 to 95.
Workability	Can be machined, bored, resurfaced, and polished.

Harvesting Salt on the Property of the Royal Crystal Salt Co., Near Salt Lake City

Electrochemists Convene In Salt Lake City

EDITORIAL STAFF REPORT

AT THE opening ceremonies of the 60th convention of the Electrochemical Society, held at Salt Lake City, Utah, Sept. 2 to 5, Gov. George Dern of Utah, Mayor Bowman, and J. O. Elton, manager of the International Smelting Co., presented in a most convincing manner Salt Lake City's advantages as an electrochemical center. There are billions of tons of sodium chloride in the Great Salt Lake area—equivalent to about a million times the total annual salt production of the United States. This is enough to maintain an alkali-chlorine industry to supply the needs of the entire Middle West and Pacific Coast for many years to come. Besides NaCl, there are available commercial quantities of glauber salt and, more important still, KCl. The potash derived from the lake salts and from recently uncovered carnalite beds would support an extensive fertilizer industry, and phosphate deposits outcrop over extensive areas. The alunite deposits of Marysvale (the largest in the country) would furnish additional potash, besides aluminum, while smelter fumes furnish enough SO_2 for the manufacture of 3,500 tons of sulphuric acid per day.

Other raw materials available and of interest are magnesium chloride, sulphur, lime, gilsonite, and elaterite. Large quantities of coal, asphalt, and oil shale are found in the state, and natural gas is piped from Wyoming and serves many of the city.

Dr. Dorsey A. Lyon, of the University of Utah, presided at the session on "cyanides," which was opened by a comprehensive survey of the status of the cyanide industry in the United States by M. R. Thompson, of the U. S. Bureau of Standards. Radical changes have taken place during the last 25 years not only in the process of manufacture of cyanides but also in the application of the various products. Most of the cyanide today is made from calcium cyanamide. Next in importance is the Castner-Roessler process, the raw materials of which are metallic sodium, anhydrous ammonia, and charcoal; sodium cyanamide being formed as an intermediate product. As regards the world's consumption of cyanides, it was pointed out by G. H. Buchanan, chief technologist of the American Cyanamid Co., that by far the largest applications are in the cyaniding of gold and silver ores; conversion into hydrocyanic acid gas for fumigation, electroplating, case-hardening, and nitriding.

In his paper on cyanides in relation to silver and gold solutions, E. J. Dobbs, chief chemist of W. Canning & Co., Birmingham, England, reported that KCN is used almost exclusively in that country, the quality of the silver and gold deposits being far superior to that obtained with NaCN baths. Furthermore, the throwing power is better with the potassium salt. Dobbs offered no satisfactory explanation for this difference in behavior of the two salts nor could any of those discussing the paper offer a possible answer. It would seem again that our knowledge of the phenomena that actually take place at the immediate surface of the cathode is little understood.

Dr. Harold K. Work, of the Aluminum Co. of

America, described his improved method of electroplating on aluminum: zinc from a cyanide bath may be plated directly on aluminum. The coating protects the underlying metal from corrosion. He stated that cyanide solutions may readily be used on aluminum after a preliminary nickel electroplate, but with some solutions special precautions are needed.

The beneficial effect of a small quantity of mercury in zinc cyanide plating solutions was reported by M. deKay Thompson, of the Massachusetts Institute of Technology. Hydrogen overvoltages and current density-electrode potentials had been measured by the author, and the good results were attributed to the high electropositive voltage of mercury. Zinc-mercury deposits at appreciably lower negative voltages than zinc alone. Prof. O. P. Watts, of Wisconsin, maintained, when commenting upon the paper, that he had never found any difficulty in plating wrought iron or low carbon steel from the ordinary, mercury-free, cyanide bath.

Cadmium Cyanide Plating Bath

A detailed study of the cadmium cyanide plating bath was submitted by Dr. S. Wernick, of the Sir John Cass Technical Institute, London. He pointed out that if conditions for good practice are observed, the bath may be operated almost indefinitely. The cadmium content should be about 30 g/L, KCN 15 g/L, NaOH 15 g/L; current density, 10 to 15 amp./sq.ft.; and the temperature of the bath, 25 deg. C. Insoluble anodes in combination with Cd anodes help to keep the metal content of the solution within specified limits.

It was pointed out by Prof. Karl Fredenhagen, of Greifswald, Germany, in his paper, that too little is known about the behavior of salts in solvents other than water. He made careful determinations of the dielectric constant and the dipole moment of pure distilled HCN. The density and internal friction of the acid had been determined and then solubilities and conductivities of various salts in HCN measured. These results, in general, check those of Kahlenberg and Schlundt and are also in accord with the author's researches with liquid NH_3 and HF as solvents. Referring to Prof. Fredenhagen's measurements on HCN, Dr. P. P. Mangold, of the United Chemical & Metallurgical Works, Aussig, Czechoslovakia, reported that the values he obtained differed appreciably from those presented, due, possibly, to the fact that for his own measurements he had used an acid which had been distilled in vacuum 25 times.

Two notable contributions to the second session of the convention dealt with modern improvements in the electric furnace art. W. E. Moore, of the Pittsburgh Electric Furnace Corp., reviewed the advances made during the past twenty years. In this period the electric arc melting furnace had increased in number 65 times; in maximum size, five times; in maximum daily capacity, 10 times; and the power consumption per unit ton output had been decreased from 600-800 to 400-600 kw.-hr. The carbon-electrode consumption had been decreased from 30-40 lb. to 8-15 lb. The total conversion cost on the output has been correspondingly decreased by reason of these improvements, as well as by reason of the more rapid type of operation and the lower maintenance, refractory, and slag costs. Moore predicted that within the next two decades the modern rapid-type electric furnace will displace a large percentage of open-hearth furnace capacity, both in the commercial steel mills and in the foundries of this country. In addition to this, the electric furnace undoubtedly will displace a large part of the cupola gray-iron capacity for iron foundries and of the air-furnace melting capacity in malleable iron and chilled iron foundries.

M. Sem, in his paper on the Soderberg electrode, emphasized the advantages of the oblong cross-section electrodes over the circular type. The first oblong cross-section Soderberg electrode was put into operation in 1921, and since then they have been used successfully in ferro-alloy and other furnaces. During recent years the lowering of the electrodes into the furnace has been made continuous and automatic. Other recent improvements are the "Wisdom ribbon," a steel ribbon which will stop the electrode when it has slipped far enough, and the dust shield around the upper part of the electrode, which makes possible a close temperature control of the baking operation. The new binder, or paste, melts and cements the particles together without ramming. The flexible cables are water-cooled, having a central metal hose through which the water is circulated, and at the same time these cables carry the water to the electrode holders.

Dr. E. F. Northrup, of Princeton, N. J., commenting on Dr. Sem's paper, related some of his own experiences with water-cooled busbars carrying 12,000 amp. And Prof. C. G. Fink referred to the Miguet electrode and its advantages over the small cross-section electrodes. Dr. Sem replied that M. Miguet had recently installed Soderberg electrodes in his own furnace in France.

A rapid and ingenious method for the determination of current efficiency of a zinc sulphate electrolyte was described by F. E. Lee and A. H. W. Busby, of Trail, B. C. Roasted blende is leached with spent-acid sulphate liquor from the cell room. Before discharging the zinc-enriched solution back into the cells, it is advisable to test it as to cathode efficiency, which is a sensitive indicator of the quality of the solution. In the past, such a test required several hours. The new apparatus and comparatively rapid test described have been in satisfactory use for several months. The underlying principle is the fact that the hydrogen-cathode efficiency is a measure of the purity of the solution and of the current efficiency of the zinc cells that can be expected during the electrolysis of the zinc solution at any given current density.

R. C. Dazell, of the Ajax Electrothermic Corp., complimented the authors on their quick and convenient method. He emphasized that the real value of the test lies in the ability to distinguish between satisfactory and unsatisfactory solutions.

Electrical Purification of Water

Prof. Jean Billiter, of Vienna, who is spending a few months in America, contributed a short description of his new method for the electrical purification of water. The large-scale purification of water in the three-compartment cell is not satisfactory, on account of the high cost of diaphragms, but a new one-compartment cell was devised based on the direct electrolysis of water with but little electro-osmotic effect. Water with 150 to 600 mg./L. of salt, and even more, can be readily purified, the product analyzing 6 to 9 mg./L. of salt. The new cell embodies two diaphragms; one of these is made of ceramic material and the other of asbestos.

In the discussion, Dr. Alcan Hirsch, of New York, recounted his own experiences and those of the pioneer, Graf von Schwerin, who devoted much of his life and fortune to developing commercial applications of electro-osmosis. It was the opinion of Hirsch that Billiter's cell did not operate without osmotic effect, and Dr. Wm.

Hirschkind, of the Great Western Electrochemical Co., also held that osmotic effects are present. Henry Howard suggested that Billiter's scheme might be used for the elimination of salt from sea water.

Prof. Thompson and Albert L. Kaye reported their measurements of the oxygen and the hydrogen overvoltages of the iron-nickel series of alloys in molal potassium hydrate at 25 deg. C. The hydrogen overvoltages of pure nickel and pure iron in hydrate are considerably lower than in acid. One set of constants in the formula $\eta = a + b \log i$ applies to the whole range of current densities for the hydrogen overvoltages; two would be required for the oxygen.

Results of a study of the passivity produced by chromic acid on the 18-8 Cr-Ni alloy were given by Prof. Fink and F. J. Kenny, of Columbia University. A comparison of the corrosion resistance toward a ferric chloride solution, a calcium chloride solution, and a sodium chloride salt spray of untreated alloy and alloy anodically treated in chromic acid showed that anodic treatment greatly increases the resistance. It was observed that the local action on areas which had been subjected to cutting and punching stresses could be avoided by anodic treatment of this material. A comparison of the corrosion resistance toward a ferric chloride solution of samples of the untreated metal, samples treated in chromic acid without the use of electric current, and samples treated anodically in chromic acid showed that the anodic treatment produced a greater increase in corrosion resistance than treatment without electric current. Furthermore, the untreated samples and samples treated without electric current corroded to a large extent by local action, whereas the anodically treated samples underwent uniform general corrosion over the entire surface, but to a smaller extent and generally without pitting.

The territory around Salt Lake offers many advantages as an electrochemical center. There are billions of tons of sodium chloride — enough to maintain an alkali-chlorine industry to supply the needs of the entire Middle West and Pacific Coast for many years to come. Besides NaCl, there are available commercial quantities of glauber salt and potassium chloride. Phosphate, alunite, magnesium chloride, sulphur, lime and gilsonite are also found near by.

The authors' observations point to the belief that anodic treatment tends to equipotentialize the surface by selectively dissolving the more anodic areas, thereby leaving the more cathodic to be coated with oxide. The final result is to form an oxide film over the entire surface of the sample, which to some extent has been equipotentialized. Such a surface should be more resistant to corrosion than one consisting of an oxide coating over a surface of non-uniform potential, for once the oxide coating is removed in subsequent corrosion the equipotentialized surface should present much less opportunity for local action and general corrosion than the other.

The electrodeposition of ternary alloys of copper, nickel, and iron from cyanide solutions was discussed by Prof. Lawrence E. Stout and Chas. L. Faust, of Washington University, St. Louis. They obtained good deposits from complex potassium cyanide solutions containing potassium tartrate. The deposition of copper is favored over nickel and iron, but an increase in current density more nearly equalizes the quantities of each of the metals depositing. The percentage of copper in the deposit is relatively much greater than the percentage of copper in the solution, but the opposite is true for iron. The percentage of nickel in the plate is slightly less than in the deposit. Cupric and ferric ferrocyanides are precipitated at the anodes, but can be prevented by careful control of the cyanide content of the baths. Any increase in temperature has an opposite influence at lower current densities to that at higher current densities.

The Saturday morning session, under the leadership of Prof. A. M. Gaudin, of the Montana School of Mines, was held at the University of Utah and was well attended. It was the first opportunity for the miners and chemists to get together since the radical changes in the whole art of flotation. Needless to say, it was difficult at times to determine what the true, underlying physico-chemical principles are; many seemingly contradictory observations were recorded.

In introducing the subject, Prof. Gaudin presented an outline of the principal physico-chemical problems encountered in flotation, in particular those dealing with the production of gas bubbles, character of the phases involved, modification of the surface of the solids, mechanics of gas-solid attachment, electrostatic effects, and economic elimination of solid-solid interfaces. This introduction to the subject of flotation was followed by several informative and interesting papers.

The "round-table" discussion over which Prof. J. A. Fulton, of the MacKay School of Mines, Reno, Nev., presided, was devoted to silver. Among the speakers were W. M. Ferry, Bradley Stoughton, Senator King of Utah, J. O. Elton, Frank B. Cooke, Prof. Fink, and E. F. Hart. Bimetallism was favored by most of the speakers. From the metallurgical point of view it would seem a pity that the metals, gold and silver, with such valuable chemical properties should be hidden away and made inaccessible for general use. A complete revision of the world's monetary standard was deemed worthy of consideration.

The outstanding social event of the meeting was the all-day excursion to the mine of the Utah Copper Co. at Bingham, thence to Magna and inspection of the concentrator, which has a capacity of 35,000 tons per day, and finally to the smelter at Garfield. The normal capacity of this smelter is 1,000,000 lb. of copper per day. Other social features included a "dip" in the Great Salt Lake and an elaborate dinner and dance at the Old Mill Club.

The award of the Acheson medal to Edwin Fitch Northrup, in recognition of his outstanding achievements in electrothermics, in particular, the development of the high-frequency induction furnace, took place in the new Kingsbury Hall of the University of Utah. President Stoughton in most admirable fashion eulogized the recipient of the medal. In accepting the medal and prize, Dr. Northrup, in his usual modest manner, referred but briefly to his own work, emphasizing instead the remarkable career of the donor of the medal, Dr. E. G. Acheson, whose recent death is mourned by all. Dr. Northrup thereupon presented a scholarly address on, "What Is Electricity"—a subject to which he has devoted his entire career.

Preventing Accidents in Tank Cleaning

By R. H. FERGUSON
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PREVENTION OF ACCIDENTS to workmen in the chemical industry is recognized today by many leading plant executives as a distinct operating problem. This is particularly true of work necessary in cleaning tanks, mechanical agitators, stills, and other containers for chemicals.

That there are hazards in tank cleaning operations cannot be denied, and many organizations plan their maintenance and cleaning work just as thoroughly as any other phase of the business. This has proved of great assistance because personal injuries to workers are prevented and trained men are kept on the job. The production schedule is interrupted only for short intervals and equipment which might be damaged should an accident occur is kept in service.

Accident prevention methods to be followed during cleaning operations should be carefully planned to fit the particular work at hand. Suppose we consider these in order. Probably the most important factor for safety in this work is the selection of the crew or gang to do the job. Men should be selected who are familiar with the dangers involved and with methods of eliminating these hazards. A good crew directed by intelligent supervision will be found of great help in doing this work safely and efficiently. This "picked" crew should be thoroughly instructed in the methods to be followed. Certain definite rules should be established and these instructions followed.

For instance, it is essential that men know the previous content of tanks they are to clean. If certain chemicals have been in storage it is possible that a slight alteration in the method to be followed will be necessary. For example, where alcohols, acids, ether, benzol, esters, etc., are involved, there is a hazard not only from asphyxiation but from skin irritations, chemical burns, fire, and explosion. Furthermore, in many cases poisoning may result.

A section of the line delivering chemicals to the container should be removed or the line should at least be "blanked off." If this cannot be done, the intake valves should be locked closed and marked with "hold cards" to prevent their being accidentally opened while men are working in the container. It is also advisable to treat drain lines in a similar manner unless they are needed in the cleaning operations. Where mechanical agitators or other devices operated by power are to be cleaned, the source of energy should be locked so that it cannot be applied while men are working in the equipment.

Every effort should be made to free the tank from the chemical which it contained before the cleaning operations were started. This means, of course, that the container should be drained first; then opened up and washed down with solutions which will neutralize the particular chemicals. In many cases it is essential to use lime or soda-ash solutions to neutralize acids and prevent injury to tanks. A number of organizations always steam out tanks which have contained flammable liquids, while others fill tanks with water and permit the container to overflow for a considerable period. This aids in eliminating the chemical and any fumes or vapors which might be hazardous. However, entire dependence should never be placed on these methods unless actual tests prove the tank gas free.

Men should never be permitted to enter tanks unless the inclosure has been thoroughly checked and found free of poisonous or other gases which might create a hazard. In many instances it is necessary to enter containers which are not gas free for cleaning purposes and in such cases fresh-air masks should be provided. These furnish the worker with fresh air from an outside source. Generally the air is forced to the mask, usually by use of a crank-operated blower.

Fresh-Air Masks, as at the Left, May Be Used Without a Blower Only Where the Hose Is Short; but Even With a Mask, Safety Usually Demands a Life Belt

The fresh air is delivered to the mask by means of a connecting hose. Canister masks should not be used unless it has been ascertained that there is sufficient oxygen within the tank to sustain life. Canisters protect only against certain percentages of gases and then only for short intervals, depending on the quantity of gas present.

It is advisable to require workers entering tanks to wear life belts and be equipped with life lines. A second worker should be placed on the outside within full view of the men in the tank. This will make it possible to remove men from the inclosure without others entering should the workers be overcome. There are cases on record where men have been overcome and the rescuer, in an attempt to save a life, has in turn been overcome by rushing into the gaseous atmosphere without protection.

The life line makes it easy to remove the man from the tank. It is always advisable for the foreman in charge of the work to make periodical inspections of all this equipment and to be sure that the face pieces of masks fit the face of the wearer properly. Air from the hose and blower only should reach the worker. If the face piece does not fit properly it will furnish little protection. It is important that the blower be continuously operated while men are wearing the masks, for otherwise they will receive too little air and will be tempted to breathe the air in the tank. The intake for the blower should always be placed so as to insure that pure air is delivered to the mask.

Proper protective clothing should be provided for the crew, particularly those entering the tank. This clothing should consist of rubber boots, preferably of the hip-length type, rubber trousers, rubber coats, and long-cuffed rubber gloves. Suitable rubber hats also should be worn for head protection, and if masks are not necessary goggles should be worn. It is a practice in many companies to require workers to cover any exposed portion of the skin with a bland ointment such as petroleum jelly. This will protect from possible contacts with acids, caustics, or other irritating liquids or gases.

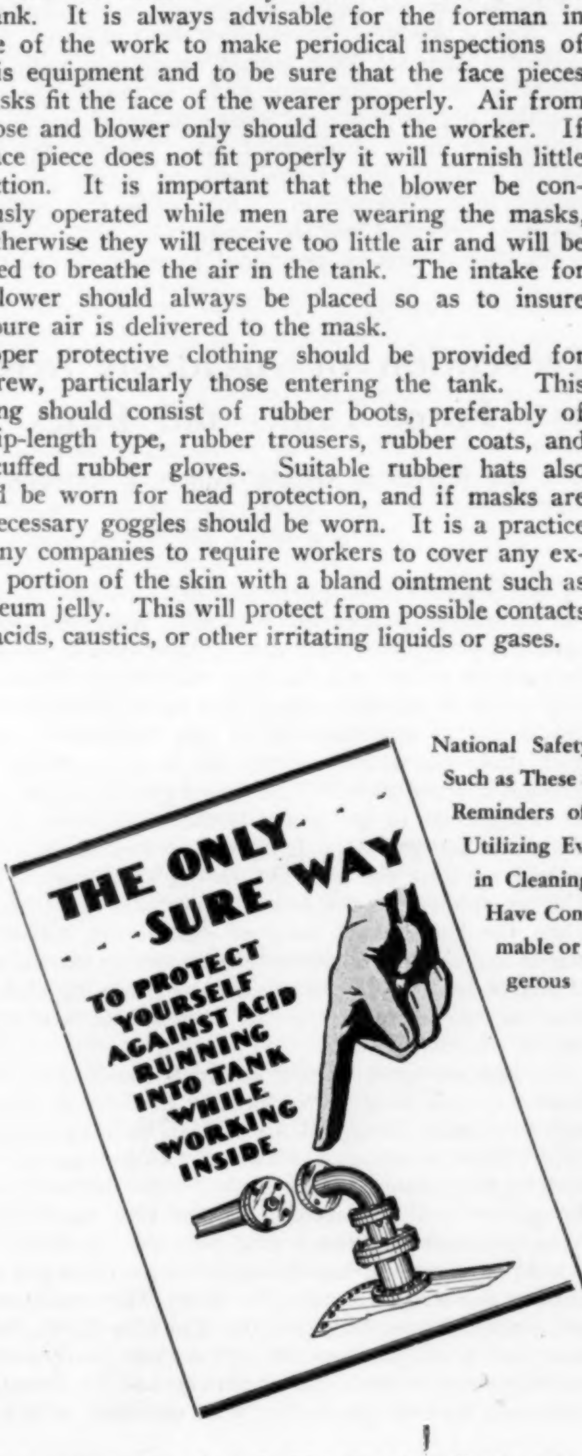
Fire and explosion hazards in cleaning tanks which have contained flammable liquids should be carefully studied to prevent serious accidents. It is good practice to make sure that the boots or shoes of workers do not contain nails or metal parts which might create a spark and cause a flammable gas to explode or burn. In several organizations the precaution is taken to use rope ladders to enter and leave tanks so that sparks cannot be created.

Where artificial light is necessary to carry on the cleaning operation only approved (Bureau of Mines) flashlights should be used. If extension cords and lamps are employed the lamps should be inclosed in a vaporproof globe and a non-metallic guard should be used to prevent breakage of the lamp. An exposed hot filament will frequently ignite a flammable gas. Particular attention should be given to the inspection of this equipment and it must always be maintained in first-class condition to prevent electrical shock or short-circuit. It is advisable to ground such extension lamps, preferably by lines carried in the same cable as the power line.

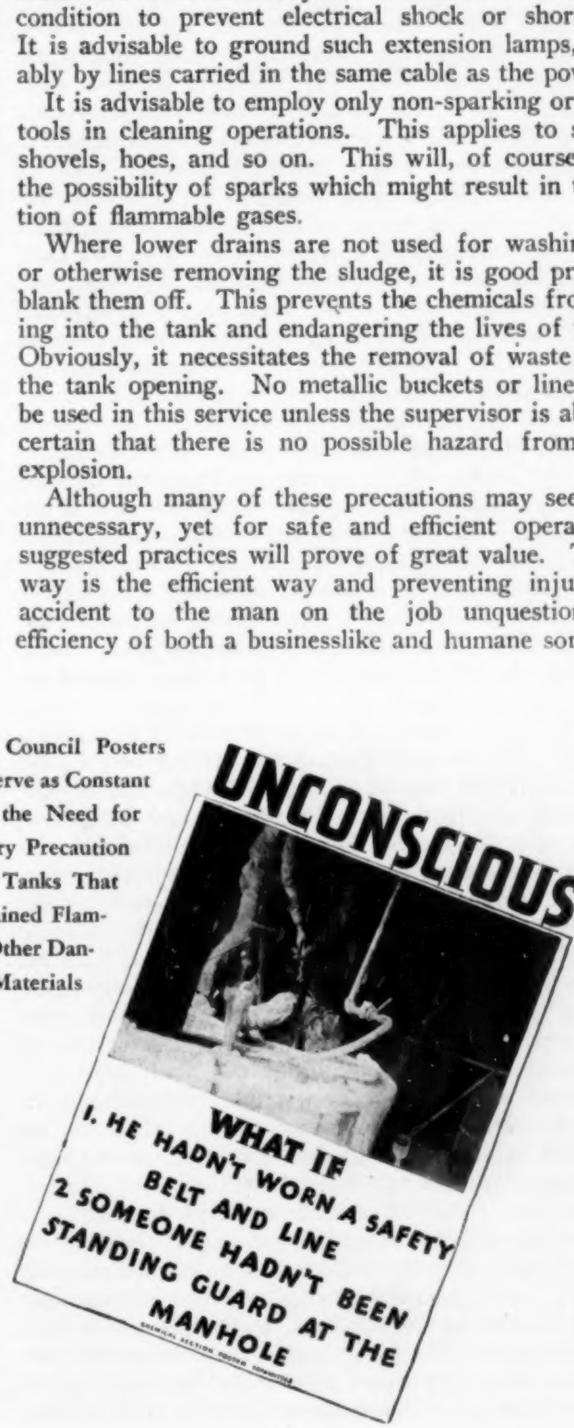
It is advisable to employ only non-sparking or wooden tools in cleaning operations. This applies to scrapers, shovels, hoes, and so on. This will, of course, reduce the possibility of sparks which might result in the ignition of flammable gases.

Where lower drains are not used for washing down or otherwise removing the sludge, it is good practice to blank them off. This prevents the chemicals from backing into the tank and endangering the lives of workers. Obviously, it necessitates the removal of waste through the tank opening. No metallic buckets or lines should be used in this service unless the supervisor is absolutely certain that there is no possible hazard from fire or explosion.

Although many of these precautions may seem to be unnecessary, yet for safe and efficient operation the suggested practices will prove of great value. The safe way is the efficient way and preventing injuries and accident to the man on the job unquestionably is efficiency of both a businesslike and humane sort.



National Safety Council Posters Such as These Serve as Constant Reminders of the Need for Utilizing Every Precaution in Cleaning Tanks That Have Contained Flammable or Other Dangerous Materials



The Safety Engineers Discuss:

Brief abstracts of several of the papers presented before the Chemical Section, National Safety Council, at its 20th Annual Congress in Chicago, October 12 to 16

Safe Practices in Entering Tanks

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WORK inside of tanks or other confined places always is more arduous and difficult than work in the open. But when the tank contains substances which, by virtue of any of their characteristics—toxicity, flammability, corrosiveness—may be harmful to human beings, or which contain machinery such as agitators or insufficient oxygen to support life, then the work in these inclosures is not only arduous and difficult but may be actually dangerous to life and limb unless suitable and sufficient precautions are taken.

While this discussion will concern itself principally with tanks which are now in service and must be entered from time to time, the purpose of this paper would not be approximated if attention were not called to the necessity for more careful consideration, in future installations, of designs which will permit at least routine cleaning and repairs to be carried on from the outside wherever practicable. If possible, manholes should be installed in both the top and bottom of tanks to facilitate cleaning and draining and to provide ventilation for cleaning or repairs. The size of manholes also should receive more consideration. There are in service today many tanks with 14-in. manholes, whereas 18-in. manholes should be the minimum and preference should be given to 20-in. manholes.

It is necessary, wherever it is required for men to enter tanks, that a man selected for his competency be placed in charge of this work. He should be thoroughly familiar with the hazards of the process and not below the rank of supervisor. One operating official on a small plant, or one operating official in each area of a large plant, provides a satisfactory arrangement. He should be specifically designated to supervise all tank work in his area by whomsoever performed, and he should be given full responsibility. At least once each month, he should personally satisfy himself as to the completeness and condition of all equipment necessary for this work.

He should supervise the designation and training of a sufficient crew of workmen for tank work, and the men should be selected with due consideration to their stability, good judgment, and physical fitness. They should be able to speak and understand English and be without recognized susceptibility to any of the hazards likely to be encountered. Before being assigned to tank work, they should be given a regular physical examination and should be reexamined with reasonable frequency thereafter. In large plants, one or more tank squads should be organized and drilled in their work. In smaller plants, or those where there is little of this work to be done, process men may be used if properly trained. The use of unskilled labor in this work should never be permitted.

Certain preparations should be made before a tank can be entered. In general, a warning sign should first be hung on the tank, after which the tank should be cut off by locking the valves, or preferably by blanking off the lines. Agitator drives must be locked or disconnected. Then the tank should be cleaned with water, steam, or neutralizing agent so far as practicable. After draining and venting, and after the actual interior condition has been determined, the supervising official should himself inspect the tank to decide on proper procedure and equipment. Only when this equipment has been provided and the danger sign removed by his order should men be permitted to enter the tank.

Prevention of Accidents Arising From Tanks and Pipes

By JOHN S. SHAW and C. L. JONES
*Hercules Powder Co.,
Wilmington, Del.*

THIS PAPER is intended briefly to give a synopsis of accident experiences with which the authors have had personal contact or first-hand knowledge during the past 25 years. (It has been possible to include here only a few of the more significant cases cited.—*Editor.*)

Mixed acid was blown from tank cars into a vertical steel tank, the acid entering the bottom of the tank through a stand pipe. This was a gravity mixer. The air compressor in the power house broke down and, as there was a slight stoppage in the vent of the tank, acid backed up into the air lines through the coil agitator. The air receiver in the power house was inadequate, so when the compressor resumed operations, mixed acid was distributed throughout the air system on the plant. The remedy is to have ample vents for mixing tanks and large air receivers in the air lines, which are drained daily.

An operator was getting ready to pump mixed acid from the scale tank on the ground level to an overhead tank containing 100,000 lb. of acid. The line to the overhead tank was equipped with a quick-opening valve and entered the bottom of the tank. The operator started the pump and attempted to open this quick-opening valve in order to deliver acid into the overhead tank. The valve stem and handle pulled away from the valve, causing the acid to spray over him. The line from the pump should have delivered the acid into the top of the tank, and a suitable type of acid cock is preferable to a quick-opening valve. It is always bad to attempt to open any kind of gate valve with pressure on the line.

An operator was standing on top of an 8x17-ft. tank while agitating a 3-in. depth of acid mud with an air pipe 14 ft. long. As he stood over the manhole, stirring the acid mud with the air pipe, the acid spurted into his eyes. He should have had a suitable acid mask, or at least goggles.

A repairman was removing the brick lining from a denitrating tower and, although the tower had been washed, the acid fumes contained in the brick were sufficient to irritate his respiratory system. As the tower was open at both the top and bottom, it acted as a flue and acid fumes drifted into the tower from a near-by operation. The combination of the two sources of acid fumes was sufficient to cause a very serious injury to the operator's health. Use of air jets, exhausters, or electrical fans are needed in this kind of work. A gas mask with air hose extending to uncontaminated air should be used.

In a somewhat similar accident a nitric-acid foreman entered an acid tank used as a mixer. The tank had been filled and washed out four times. While he was in the tank he did not notice any fumes, so he cleaned out two buckets of mud which were in the bottom of the tank. The mud contained acid, and when disturbed, the fumes were set free. The foreman inhaled a sufficient quantity to cause him a very serious illness. Tanks should be inspected with strong drop lights before men enter them.

A horizontal storage tank with a capacity of 17,500 gal. suddenly collapsed so that the two sides flattened and touched together. The tank had been cut out hot and not vented. It contained light petroleum solvent and, on cooling and condensation of the vapors, a partial vacuum was caused, resulting in the collapse of the tank. Tests performed as a result of this accident showed that a vacuum as high as 22 in. might have been developed under the circumstances. The accident goes to prove that tanks should have ample vents.

A boiler maker entered an oleum tank to make repairs. The acid line which was used for delivering acid to the tank was not disconnected nor was a danger sign hung on the valve of this line. While the boiler maker was making repairs there was a change of shifts and an operator, without knowledge of the presence of the boiler maker within the tank, pumped hot oleum into the tank. The boiler maker lived, but suffered terrible burns, especially on his legs and back. It is quite obvious that all pipe lines should be disconnected from tanks and blanked off before operators or repairmen are allowed to go within the tanks. In addition to this, the free use of danger signs should be adopted.

Mixed acid arriving in a tank car was to be blown from the car into a storage tank. It was cold weather. There was no air receiver in the air line. When the air was turned into the car the tank ruptured and the mixed acid flooded the building, which immediately took fire. The lives of two men were lost and the fire alone caused damage of over $100,000. It is thought that water in the air set up a sudden pressure in the mixed acid, which caused the tank to rupture. Air lines should be equipped with large air receivers and should be bled before air is ever used for blowing mixed acid or other chemicals which generate heat as a result of the action of water.

Through negligence on the part of a repairman, the pipe line leading to a storage tank had been opened for repairs and left open at the end of the shift without his reporting it. The succeeding shift operator, not knowing of the opening in the line, proceeded to pump through the line 72,800 gal. of paint thinner which was lost before the situation was discovered. Fortunately, there was no fire. The remedy for such a case as this is plain. It starts at the plant manager's desk.

An employee was disconnecting an acid line which stood about 6 ft. from the floor and when he attempted to unscrew the union, the line broke and remaining acid in the line ran out and dropped into his eye and on the left side of his face. There was a sag in this particular line which did not permit all the acid to drain out; however, the injury could have been avoided had the man exercised greater care. He should have worn goggles or a mask. In addition he should have worked from above the line and not from below.

Proof That Solid CO_2 Is a Safe Refrigerant

By D. H. KILLEFFER
Dry-Ice Corp. of America
New York City

EXPERIENCE covering a period of five years and the use in refrigeration of tens of thousands of tons of solid carbon dioxide, has definitely proved its safety. The records of our own company show only five lost-time accidents, due to the peculiar nature of the material handled, in the six-year period ending June 30, 1931. The only real source of accidents in this new industry has been the practical joker.

General distribution of a material having a normal temperature of —109.6 deg. F. was once looked upon as a probable cause of wholesale frostbite; the generation of huge quantities of carbon dioxide gas at high concentrations as a result of use of the new refrigerant was expected to be a source of danger on account of smothering or drowning of persons by the gas; and the pressure generated by the evaporation of a solid directly to a gas when confined within refrigerators was believed by some to be a source of dangerous explosions. None of these possibilities has materialized, thanks to simple, safe, obviously logical methods of handling.

In five and a half years only four cases of frostbite have been serious enough to require an employee to be sent to a physician, and only two of these required the employee to lose any time from his regular work. Because it is a solid and is covered with a gas film of low-conductivity CO_2, it is difficult for the flesh of the handler to establish intimate contact with solid carbon dioxide. Hence adequate protection is easy to devise. All that is necessary to insure continuity of the protective film is for the handler to wear gloves of any ordinary variety. Should frostbite occur, it may be treated as one would treat any ordinary burn.

Hazard from carbon-dioxide smothering is almost non-existent so far as our experience has gone. The only effect of high concentrations on a human being is to stimulate breathing in an effort to void the lungs of the gas. Of course, smothering will occur if the customary oxygen cannot be obtained, but if one is rescued in time, there are no after-effects. Furthermore, the quantity of carbon dioxide given off in using this material for refrigeration is generally so small as to be negligible. Finally, danger from explosions in refrigerators using solid carbon dioxide has also been found to be non-existent, for the reason that such equipment cannot be built tight enough to build up pressure.

More Whys and Hows in

LEATHER MANUFACTURE

By W. K. LEWIS

Professor of Chemical Engineering
Massachusetts Institute of Technology
Cambridge, Mass.

AND

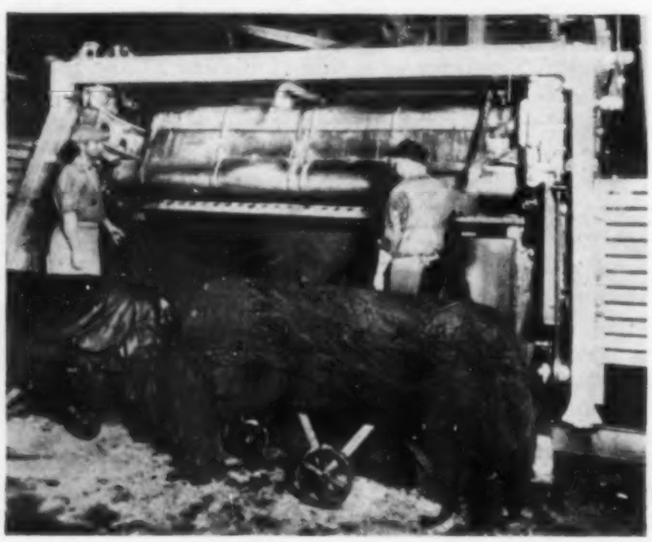
R. H. W. LORD

President, Lord Tanning Co.
Woburn, Mass.

In an earlier article, published in the August, 1931, issue of *Chem. & Met.*, the authors explained the fundamentals of leather technology, with particular reference to the production of the heavier leathers. In the present article both the treatment of hides for light leather and the uses of leather are briefly discussed

As WAS EXPLAINED in a previous article, the tanner must resort for his most important technique in controlling the texture of his finished leather to the device of loading, a process not unlike the loading that is practiced by the textile finisher. In the case of heavy leather—sole leather, for example—it was shown that a stiff, hard, and boardy product could be obtained by depositing a large amount of tanning material within the spaces between the fibers. In the manufacture of light leather, however, one normally wishes to avoid all filling of the voids between the fibers. Indeed, where a particularly soft and flexible product is required, it may be desirable to eliminate a part of the substance of the hide itself in order to leave more room for play and movement of the fibers that remain. Thus, the use in the beam house of old limes (i.e., lime liquors which have long been employed and to which with each new batch an equivalent amount of fresh lime is added) results in the production of a softer leather, whereas de-hairing with sulphide or with fresh limes gives a firmer product. Apparently, the old limes attack and disintegrate some fraction of the hide itself, as is indicated by the presence of the amines which McLaughlin has found in them.

Wringer for Squeezing Tanned Hides Partially Dry While Smoothing and Stretching Them



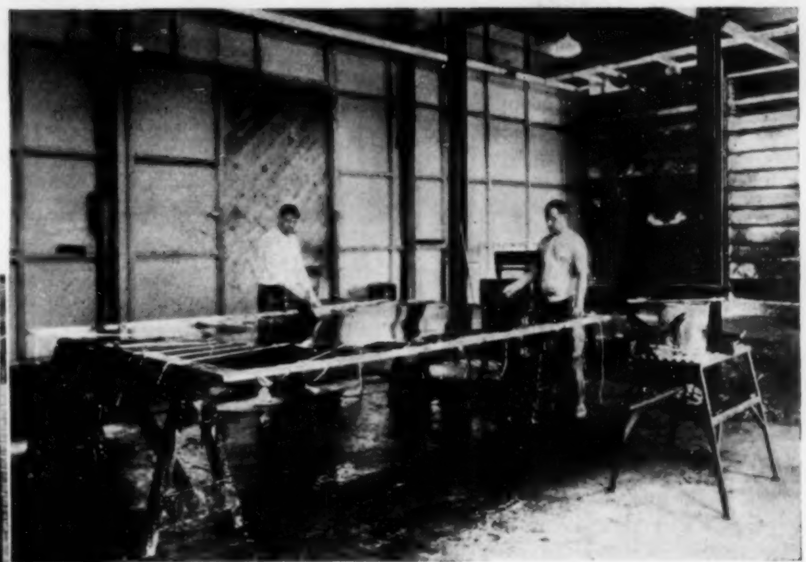
The action of the bate in the beam house—i.e., treatment of the skins with digestive enzymes in the presence of buffer solutions to control the pH—is undoubtedly similar in character, removing, according to Wilson, specific structures which affect the appearance of the grained surface of the finished leather but attacking also some of the finer fibers of the main body of the skin. The tanner can profoundly modify the structure and feel of his product by controlling the whole course of its treatment through the beam house.

There are certain outstanding differences between the technique of chrome and of vegetable tanning. In the first place, the effective tanning agent is a complex, basic chromium ion which is soluble, even colloidally, only in acid solutions. One must, therefore, have the skin highly acid before the process of chrome tannage starts, in order to have the tanning agent diffuse through the skin structure. Since one wants a product which is soft and strong rather than stiff and thick, one must avoid the swelling of the skin which is essential in sole-leather tanning. Furthermore, one must avoid it despite the fact that in preparation for the tanning operation the skin must be made far more acid than in the case of sole leather. Consequently, it is imperative to employ along with the acid some sort of an agent which will prevent its plumping action.

It is well recognized that the swelling of any amorphous solid in any solvent can be depressed by the addition to the solvent of material miscible with the solvent but without effect on the amorphous body. Thus, acetone will depress the swelling of rubber in benzol; benzol will depress that of nitrocellulose in ester solvents; alcohol that of gelatin in water, and the like. The cheapest dehydrating agent of this sort available for the use of the tanner is common salt. Therefore, in the preparation of the hide for the process of chrome tannage it is pickled in a solution of dilute sulphuric acid and salt, with relatively little of the former and large quantities of the latter. In this way one can bring the hide to the required acidity without appreciable swelling action. The hide thus prepared, when treated with solutions of

trivalent chromium, is penetrated through and through. Furthermore, if the acidity be not too high, considerable chromium is actually absorbed by the skin. In order, however, to have it take up the chromium properly, neutralization of the acid is necessary. This

Photographs Courtesy of A. C. Lawrence Leather Co.



Left: Band-Knife Used in Splitting Hides; It Is Similar in Construction to a Band-Saw. Above: Lacquering a Hide Which Is to Be Made Into Patent Leather

should obviously be carried out gradually and progressively in order to get uniformity of action throughout the thickness of the skin.

When chromium has been thus precipitated from aqueous solution on the skin, the superficial properties of the hide have been changed to a remarkably slight degree. The slipperiness of the skin has been reduced decidedly, but otherwise, except for the green color, its appearance is much the same. However, an extraordinary and far more fundamental transformation has occurred. Prior to the precipitation, the fibers possess a positive affinity for water. Furthermore, their reaction toward water is reversible. The skin can be dried out and wet back at will. At the time the chromium was added the skin was highly hydrated. After the addition the skin is still hydrated, but it is now in a condition where, once dehydrated again, it permanently loses its affinity for water. In other words, the skin is now an irreversibly hydrated material.

The parallelism to the behavior of silicic acid in the formation of silica gel is striking. When silicic acid is set free from water-glass solution by hydrochloric acid under proper conditions, it is a characteristic, highly hydrated emulsoid. However, in this condition the water of hydration which it holds apparently is an inheritance from its ionized state in the water-glass solution. It has no permanent affinity for this water, as is proved by the fact that, allowed to stand, it sloughs off this water and progressively dehydrates, thereby setting into the thing we know as silica gel. Once thus set, it can never again be brought into the hydrated condition, except through a series of roundabout and drastic chemical transformations. Apparently, the fiber of the hide is transformed by the precipitation of the chromium in a similar way. The precipitation does not eliminate the water. The hide fiber is still quasi-plastic. If, however, one eliminate the moisture by drying, the rehydration of the skin, at least to anything approximating its former state, is no longer possible. Thus, as already pointed out, if a piece of raw hide be dried out, it is converted into horn by the adhesion of the fibers of the mass, due to the plasticity of their surfaces. To a lesser degree, the same thing occurs on the drying of chrome-tanned leather. The difference, however, lies in this the fact that the raw hide can be wet back to its original soft, hydrated state, whereas the leather cannot. It is, therefore, imperative to fat-liquor chrome-tanned leather after tanning, before drying out, so as to prevent the coalescence of the fibers on dehydration. Once thus properly dried, the fibers have lost their plasticity and the leather can be wet back indefinitely without adhesion of the fibers.

Chrome leather may be dyed either before or after drying. The dried leather is dampened back, tacked out on frames in a stretched condition, and again dried. The frames greatly reduce the shrinkage on drying, yielding a larger area of product and leaving a leather which will subsequently stretch far less when wet. The product can be finished by the application of a surface coat of pigments or dyes bonded together with agents such as blood albumen, casein and the like, or surface dopes such as the drying oils or lacquer finishes of patent leather may be used. A gloss can be developed by pressing

Buffing Machines Used in Finishing Tanned Hides Employ a High-Speed Buffing Wheel

between smooth, hot plates or "jacking" by the friction of a glass cylinder slipping over the surface. The leather is strong and durable and is used almost exclusively for shoe uppers. Its preeminence in this field is perhaps due largely to the fact that, when wet, its fibers are not plasticized, so that on drying out again it is not boardy. Those who are old enough may remember the difference in this regard in the vegetable-tanned shoes of a generation ago.

Where fullness of texture combined with softness is desired, vegetable-tanned leather can be made by employing, not the astringent tannins of heavy leather manufacture but the milder, less astringent ones. For specialty leathers a number of other tanning agents are available such as alumina, the condensation products of formaldehyde, the oxidation products of certain oils (apparently aldehydic in character), certain new synthetic tanning agents that have been developed in recent years, and the like. However, the backbone of light leather manufacture is still chrome tanning and, to a distinctly lesser degree, vegetable tanning.

ENGINEERING and industrial uses of leather are small in comparison with its utilization in shoes, gloves, bags, traveling cases, and the like. From the technical point of view its most important characteristic is its combination of strength and remarkable ability to endure repeated flexing. This is best illustrated by its use in belting. Cases are on record in which leather belts have been employed in heavy duty under almost continuous conditions of service from 25 to 40 years. However, to secure performance of this sort the belt must be protected from overload. Another case in which leather is employed to the practical exclusion of other materials is the use of soft, vegetable-tanned sheepskins in the construction of dry gas meters. Its superiority for this purpose is based on its ability to withstand indefinite flexing, together with the extraordinarily low resistance it offers to the flexing motion. A movement to replace vegetable tannage by chrome in meter construction is on foot. Leather is unexcelled for use as piston packing for pumps for gasoline and similar liquids. It is important as a fabric for polishing operations and sometimes is employed as a filtering or straining medium. Its use as raw hide was formerly extensive in the construction of small pinions and mechanical parts, but it is here encountering strong competition from vulcanized fiber and similar materials.

A serious limitation of leather is its sensitiveness to chemical action. It cannot be used in the presence of strong acids or alkalis, or active oxidizing agents. A second limitation is its sensitiveness to moisture. It adsorbs moisture from the air, even at low humidities. Furthermore, this adsorption makes the leather stretch. Thus, vegetable-tanned belting must not be used where it is likely to get soaking wet, but the effect on it of mere atmospheric humidity, even though high, usually is unimportant. As pointed out above, chrome leather is far less sensitive to moisture than vegetable tanned. Both adsorb it and both stretch somewhat in doing so, but chrome leather resists completely the leaching and gelatinizing actions which water exerts on the vegetable-tanned product. However, this very capacity of leather to pick up moisture is a major reason for its superiority in the construction of shoes. The inner surface of the upper leather adsorbs the moisture from the foot. This moisture diffuses through the leather with extraordinary rapidity, almost as if it were dragged along by capillarity. Consequently, the moisture content of the outer surface of the leather is high and the evaporation of the moisture into the air correspondingly rapid. Hence, the moisture given off by the foot as perspiration can escape through a leather shoe almost as rapidly as if the foot were bare.

Various methods of waterproofing leather have been proposed. Most of these involve impregnation with fatty substances. This interferes with flow of liquid water through the voids, but does not greatly retard the capillary movement of adsorbed water along the fibers. In other words, samples of this sort are water-resistant, but in no sense waterproof. Efforts have been made in recent years to impregnate leather with rubber latex as a waterproofing device, but the success of this scheme is not as yet entirely assured. It seems certain that any waterproofing technique which interferes with the capillary movement of the water along the fibers will

Sorting and Measuring Tanned Hides; Machines at Left Ingeniously Integrate Hide Area

make the product unfit for upper leather and there is evidence to indicate that the same is true of sole leather, although the foot undoubtedly breathes less through the latter than the former. The ideal treatment would fill the voids with a material which would prevent liquid water from entering and passing through the leather but would not interfere with the travel of the adsorbed water.

In using leather as an engineering material of construction one must remember two important points. In the first place, it does not follow Hooke's Law. In the case of belting, one usually assumes the elongation proportional to the square root of the load rather than to the first power. This tendency to stretch relatively more at low loads than at high is, of course, due to its fabriclike structure. In the second place, leather, like all amorphous materials, has a very low elastic limit. Under moderate loads it develops considerable permanent set. However, this effect fades away rapidly under sustained or repeated load. This is the reason for the necessity of relatively frequent tightening of new belts. However, while the tendency to undergo permanent set never completely disappears, it is soon reduced to an almost negligible point. It is on this account that a properly loaded belt, once broken in, will run for months or even years before retightening becomes necessary.

So unique is leather in its combination of strength, flexibility, and durability that one is inclined to the opinion its industrial uses would be far broader were engineers better acquainted with all its characteristics. The tanner has been lax in securing dependable data on the properties of his product and making them available to the engineering profession.

Readers' Views and Comments

An Open Forum

The editors invite discussion of articles and editorials or other topics of interest

What Is Ahead for Sulphuric Acid?

To the Editor of Chem. & Met.:

Sir:—In the article, "Agricultural Aspects of Sulphur and Sulphur Compounds," which appeared in your July issue, the authors, J. G. Lipman and H. C. McLean, have not only presented striking figures on the annual loss of sulphur from our soils but have stressed the important fact that sulphur is one of the essential plant foods. While admittedly this latter fact is not a new discovery, the authors have served a very valuable purpose in reminding us of it at this time. This is for the reason that in our efforts to effect economies by developing new methods or by substituting less costly raw materials in our present processes, we sometimes overlook factors which should exercise considerable control over our decisions.

In developing substitutes for sulphuric acid in the manufacture of fertilizers, obviously we should not lose sight of the food value of the sulphur present in our commercial acid phosphates. And in other industries there are comparable conditions which if taken into account, I think, will result in a favorable view as to the future of sulphuric acid.

For the past several years I have had occasion to make a careful study of the acid market with particular reference to processes which might affect its trend, and without having any serious quarrel with the facts given in recent articles, I know that many people who are not entirely familiar with the developments cited have read into them the meaning that the consumption of sulphuric acid may show a marked decrease in the next few years. This I do not believe to be true.

There are, of course, cases where sulphuric acid has already been largely displaced. Reference has been made at various times to the fact that nearly all nitric acid is now made by the oxidation of ammonia, rather than by potting Chile nitrate with sulphuric acid. A similar case is the virtual abandonment by sulphuric acid chamber operators of nitre potting as a source of nitrogen oxides, with the substitution of ammonia oxidation or direct addition of nitric acid. But calculation shows that neither of these changes has lessened sulphuric acid production materially. Using 1927 production figures, it is apparent that if no sulphuric acid had been used for either purpose, the reduction in H_2SO_4 production would have been about $3\frac{1}{2}$ per cent on account of nitric acid, and 1 per cent on account of nitre potting in chamber plants.

The use of nitric acid instead of sulphuric in the treatment of phosphate rock has been suggested. The facts are, that the treatment of phosphate rock with nitric acid makes a material which is hygroscopic, and hence not suitable as a fertilizer. Calcium nitrate, although the cheapest salt produced from nitric acid, is never sold as a fertilizer without special treatment. Evidence of this is in the fact that there are a number of products now being marketed which contain calcium nitrate that has either been especially treated or is combined with other chemicals so as to eliminate its hygroscopic properties. Complete acidulation of phosphate rock with nitric acid would make a fertilizer material whose physical properties would be such that it could not be used in fertilizer distributing machines.

Aside from the matter of physical form, and assuming that the difference in cost between sulphuric and nitric would be met by the nitrogen value of the latter, any real tonnage competition by nitric acid in the acidulation of phosphate rock seems to be out of the question for two reasons: First, shipment of nitric acid to the many small superphosphate plants located around the country would be both difficult and expensive. For most localities, therefore, it would be cheaper to use sulphuric acid to make the phosphate available, and add ammonia or an ammonium salt for the nitrogen of the fertilizer rather than to try to obtain the available phosphate and the nitrogen in one operation by the use of nitric acid. Second, it is very difficult to make the farmer change his fertilizer habits. There is no question at all that for most localities the farmer could obtain cheaper fertilizer if he would use more concentrated mixtures. The fertilizer industry and the technical experts of the U. S. Department of Agriculture and the departments of agriculture of various states have been preaching this fact to the farmer for the past 15 years, and while the trend toward more concentrated fertilizer is slowly upward, this movement has been so slow as not to make any visible difference in the farmer's consumption of the old standby, calcium superphosphate. Furthermore, as Dr. Lipman points out in his article, the sulphate in calcium superphosphate is recognized as a valuable fertilizer in itself.

The slow trend of the fertilizer business has been toward the use of more concentrated fertilizers, such as double and triple superphosphate and ammonium phosphate. In making these materials phosphoric acid is used in place of sulphuric acid, but sulphuric acid is itself used for making the phosphoric acid and will continue to be used largely unless some less costly furnace process for making that acid is developed. Consequently, the use of phosphoric acid by gas and byproduct coke ovens to dispose of their ammonia as ammonium phosphate will make no difference at all in the consumption of sulphuric acid provided the phosphoric acid is made by the sulphuric acid process.

A very serious objection to the use of the blast furnace for phosphoric acid production is the fact that it is a very inflexible machine as regards production. Economical operation of a blast furnace means close-to-capacity operation and any interruptions involving the shutting down and starting up are costly. Similarly the

proper maintenance of such a furnace in a standby condition may be an expensive item. The electric furnace is subject to the same lack of flexibility, since a continuous load is necessary in order to obtain favorable contracts for the large amount of electrical power required. This lack of production flexibility in either type of furnace merits careful consideration, particularly since the history of fertilizer companies demonstrates that the demand varies greatly from year to year, depending on the prosperity of the farmer and the economic situation as a whole.

With the improvements in the hydrogenation process for making gasoline, it is expected by some that the petroleum industry will use very much less sulphuric acid, and that it may even become an important producer of sulphur. There are, however, certain factors which are bound to exercise considerable influence over this development. The hydrogenation process requires a very large capital expenditure and is a process which will only come into general use when the supply of medium-boiling-point oils, such as gas oils, becomes depleted. For several years, at least, hydrogenation will only be an auxiliary to existing processes because our supply of petroleum oils will probably enable us to make gasoline more cheaply by using present-day methods. One essential advantage, of course, in the use of hydrogenation over other methods is that through it heavy or very asphaltic oils can be converted into gasoline, and under present economic conditions therefore the hydrogenation process probably will be used only for making certain high grades of gasoline and lubricants. In consequence, I believe that it will be many years before it is a tonnage factor in the petroleum business.

Regarding the sulphuric acid used by the petroleum industry, the percentage of acid used in the refining of gasoline is small. According to the Bureau of Mines, the sulphur content of perhaps 90 per cent of the gasoline is already below the present limit of 0.1 per cent with the usual refining methods. Should the permissible limit of sulphur in gasoline be raised above 0.1 per cent it would have little influence on the consumption of sulphuric acid by the petroleum industry. In fact in some refineries in this country no acid is used in refining gasoline, vapor phase absorption followed by "doctor" being the practice. Sulphuric acid is mostly used for refining kerosene, lubricating oils and other petroleum products.

As regards the petroleum industry, it is probable that the *percentage* of sulphuric acid used for refining purposes per unit of product will tend to decrease in the next few years, but refined petroleum products in total amount may be expected to increase. The industry is rapidly coming under scientific control and this means the use of a smaller percentage of sulphuric acid per unit of refined product. As against this decrease in straight refining practice the petroleum industry will probably use sulphuric acid in making new products. This is indicated by the fact that many of the large refineries are already preparing to treat their still gases to form various types of alcohols and esters useful in the lacquer and chemical industries.

I might say in conclusion that there is nothing in the recent literature that would make me change my opinion that the trend of sulphuric acid consumption will continue upward about as in the past. I realize fully that in these days of constant research and scientific discovery it is impossible to look very far into the future, but one must remember that sulphuric acid is such a basic commodity and enters at one stage or another into the manufacture of so many products that new developments resulting from research are just about as likely to demand new quantities of sulphuric acid as they are to decrease its use in existing processes.

Chemical Engineer, New York City. — RAYMOND F. BACON.

To Protect a Name's Identity

To the Editor of Chem. & Met.:

Sir:—It has come to our attention that there appeared in the May 6, 1931, issue of the *London Financial News* an item in regard to legal action between Acetate Products Corp., Ltd., and Commercial Solvents, Ltd., of London, England. The article involves claims on a contract which arose out of a sublicense to work a process for the production of acetic acid.

Owing to the similarity of the name Commercial Solvents, Ltd., to that of Commercial Solvents Corp., it is felt that some confusion may be created in the minds of those who may hear of this action. We wish to state that Commercial Solvents, Ltd., is not connected in any way with Commercial Solvents Corp. or its London office.

In September, 1929, our London office notified us of the registration of a new British company called Commercial Solvents, Ltd., but after searching inquiry we were advised by our attorneys that nothing could be done toward obtaining a revocation of the registration of the name. — C. L. GABRIEL.

Vice-President,
Commercial Solvents Corp.,
New York.

Plastic Products and Producers

In answer to the foreword introducing the chart of "Plastic Products and Producers" in *Chem. & Met.'s* August issue, several correspondents have been kind enough to submit the corrections that a close reading has proved desirable. The revised information is the following:

On p. 461: *Ace-Ite* listed as CA, is actually a bituminous plastic manufactured by American Hard Rubber Co. at Akron, Ohio.

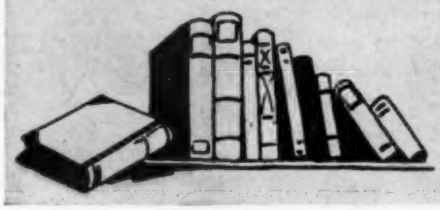
Aroclors should be inserted as a chlorinated-diphenyl series, used in lacquer and varnish compounding, and made by Swann Chemical Co., Anniston, Ala.

On p. 462: *Cumar* should be inserted as a cumarone-base plastic made by the Barrett Co., New York City.

Formica is made by the Formica Insulation Co., Cincinnati, Ohio, which is in no way connected with the Bakelite Corp., as originally printed.

At this opportunity attention is also called to the fact that reprints of the original chart have been made available because of numerous requests. These are now immediately obtainable in moderate quantities at a charge of 10 cents per copy.

Chemical Engineer's Bookshelf



Advances in Alkalis

Alkalien und Erdalkalien. By *Bruno Waeser*. Verlag Theodor Steinkopff, Dresden, 1931. 196 pages. Price, 15 M.

Reviewed by N. A. Laury

THIS is Volume 26 of Rassow's Technische Fortschrittsberichte and the third of this series written by the present author. The work is essentially a review of the more recent technical literature and patents of practically the whole list of commercial inorganic salts of the alkalis and alkaline earths. Within its comparatively few pages there are over 2,400 references—patents in the majority of cases. These are given as they come to hand with little to indicate their industrial value, but one is impressed by the author's ingenuity of statement and economy of words.

The use that can be made of such a compendium is much like that of an abstract journal, differing mainly as a judicious selection of material. While not as accurate, and showing lack of thorough study of the originals abstracted, as evidenced by occasional errors (for example, on p. 121, "$NaHSO_3$ aus Na_2SO_3 und SO_2"), it is in more convenient form, neatly printed, and copiously indexed. The salts are clearly classified, commercial statistics are quoted, and a conventional outline of a process is generally described. It is a handy means of getting quickly posted on general aspects.

Rayon Manufacture

The Manufacture of Artificial Silk, With Special Reference to the Viscose Process. Second Edition. By *E. Wheeler*. D. Van Nostrand Co., New York City, 1931. 177 pages. Price, $5.

Reviewed by T. R. Olive

WHEN the earlier edition of this monograph was first reviewed here in 1928, the opinion was expressed that the author had done a remarkably good job within the narrow confines of 150 pages. The primary objective of Mr. Wheeler's work was the instruction of chemists, chemical engineers, and intellectually equipped laymen rather than those actively engaged in the production of rayon. And so far as it went, the volume fully carried out the aims of its author. The same may be said of the second edition. Although it has little or nothing to offer to the rayon technologist, in comparison with such books as Avram's, it will serve excellently for the man who needs only a general picture.

The plan of the first edition has been in nowise changed. Much of the same material has been retained, but it has been brought up to date with a considerable quantity of new information, including over 20 new illustrations. The added material has been distributed quite generally through the sections on processes, properties, uses, and economics of rayon, although, as the title would suggest, the emphasis of revision has fallen on viscose rayon.

Stress Effects in Metals

Creep of Metals. By *H. J. Tapsell*, Oxford University Press, New York City, 1931. 285 pages. Price $12.

Reviewed by M. S. Northup

IN GIVING detailed descriptions of apparatus and methods, together with the results of many investigators, both in this country and abroad, this book covers the subject of creep of metals very fully. The comparisons drawn indicate the wide variations in reported results for similar materials. Mr. Tapsell's discussion of the effects of overstrain and creep on the properties of metals is worthy of study by the many investigators in the field.

The author presents a comprehensive review of the known phenomena of the creep of metals at high temperatures and correlates detailed information from many investigators. Two chapters are devoted to the estimation of working stresses, in the first of which stresses are based on a specified total creep within a given time, and in the second wherein stresses are estimated for no creep in the material. Suggested working stresses by various authorities are compared both in tabular and graphic forms. The author suggests that a factor of safety of 3 on the limiting creep stress gives working stresses for medium carbon steel between 650 and 1,025 deg. F. and believes that a reasonable margin of safety on both stress and temperature is shown.

After a critical analysis of the available creep data, the author points out that direct comparison between the results of one investigator and those of another is difficult because of the various ways in which the data have been presented. He also points out that, with the exception of some short-time creep test data from two sources, it would appear that for temperatures above 840 deg. F., little gain in creep strength may be expected in carbon steel by an increase of carbon above 0.4 per cent.

An interesting, and perhaps useful, comparison between creep results is shown in the chapter on creep properties of ferrous metals. Curves are presented showing the ratio at different temperatures of the average creep limits of various carbon steels to their corresponding values at 750 deg. F. These curves run rather close together, although the data from which they are obtained are widespread. Tapsell notes that Bailey

believed that a reduction in working stress in accordance with the ratio curves would be satisfactory.

Mr. Tapsell's study of the properties of materials at elevated temperatures leads him to the conclusion that the limiting creep stress bears no direct relation to the short-time ultimate stress, the curves of constant permanent set, or the limit of proportionality, and that the maximum strength of a material under prolonged loading must be determined from long-period creep tests applied to each material.

Bringing Up Business

POLICY AND ETHICS IN BUSINESS. By *Carl F. Taeusch*. McGraw-Hill Book Co., New York City, 1931. 624 pages. Price, $5.

Reviewed by J. R. VAN ARSDALE

WHETHER we like it or no, economic factors today, increasingly complex and baffling in their bearing on life, challenge the age-old hierarchy of politics and religion in the mingled pattern of social organization. Business and industry, in America, are no longer a means to a living. They are becoming a way of life. High time that thinkers capable of disinterested analysis began to cut away some top growth of this expanding phenomenon to examine critically its basic roots. For this new "way of life" requires intelligent direction and the philosophic exercise of control.

Prof. Taeusch, in this book, gives impetus to the fulfillment of this need. He does not offer here 600 pages of light reading, but he throws out on almost every page an arresting array of facts or a critical concept that at once challenges and intrigues the mind that is probing for richer ideas. Although he relies on the archives of business for his source material, he never allows the reader to lose sight of the essential fact that business is but one phase of the social entity, inextricably intermingled with all other threads that form the pattern of our civilization.

In the first chapter he lays in the broad background strokes—the Land, the People, and Their Ideas—against which he executes deftly his detailed filigree of ethical considerations and policies: Business and the Sherman Law, the Structure and Dynamics of Business, the Ethics of Price Policies, Unfair Trade Practices, Self-Regulation in Business. He dodges no issues nor spares any heads, although throughout he bears a spirit of positive and constructive optimism.

Prof. Taeusch believes that business has emerged from its youthful fascination for smart-aleck tactics, that it is evolving a mature concept of intrinsic social responsibilities. He makes his readers share this optimism, at least to the extent that no man will lay aside this provoking volume without a firmer grasp of the realities necessary in the protection of a public whose interests are integral with sound business procedure.

Fuel Chemistry Manuals

LABORATORY MANUAL OF GAS, OIL, AND FUEL ANALYSIS. By *Carl J. Engelder*. John Wiley & Sons, Inc., New York City, 1931. 236 pages. Price, $2.75.

Reviewed by WILBERT J. HUFF

IN THIS manual, Prof. Engelder describes 34 experiments designed for the student who wishes to acquire some familiarity with the elements of testing gas, oil, and solid fuel materials. Some mention of prominent publications in the general field is noted for each main division of the subject matter. The appendix contains 19 useful tables.

Such a manual no doubt serves a useful purpose in some college or university courses by simplifying the task of the instructor in compiling subject matter, and Prof. Engelder's work therefore should find some application. The examination of much of the industrial materials covered by the scope of this book, however, entails certain somewhat empirical procedures, and the data obtained are only of maximum value when it can be attested that a certain very definitely prescribed method has been followed in every detail. For these reasons, the industrial laboratory depends upon primary publications, such as those of the A.S.T.M. or the Federal Specifications Board. The reviewer is of the opinion that the maximum pedagogical benefit is derived when students also are obliged to use primary sources directly, rather than manuals prepared therefrom.

This manual reflects the rather universal and regrettable educational laboratory practice of giving extended consideration to the manipulation of the sample in the laboratory and very minor attention, if any, to the methods of sampling. An omission of some moment is the apparent failure to stress the importance of calibrating gasometric apparatus. Errors of more than one per cent may readily occur in a commercial gas analysis from this cause when certain equipment is used.

As a mark of the author's endeavor to include in the manual developments in modern practice may be mentioned the experiments on the low-temperature fractionation of gas and the determination of carbon monoxide by iodine pentoxide. The Abel still described in the first-mentioned experiment has not as yet received the wide acceptance accorded other apparatus, and the use of liquid air, rather than liquid nitrogen, in conjunction with hydrocarbon analysis involves certain hazards.

The compilation contains a number of features which will render it useful as a suggestive reference for instructors in gas, oil, and fuel analysis and it will no doubt find a place in the laboratory libraries of many industrialists.

Recent Arrivals

DECHEMA-MONOGRAPHIEN, 13-37, Vol. 3. Verlag Chemie, G.m.b.H. Berlin. 1931. 283 pages. Price, 12.50 M.—The third volume of this series contains 24 pages under the general title "Rationalization in the Chemical Plant," read before the main meeting of the society last year. These papers cover various general and individual phases of plant modernization, naturally with the disadvantage that such collections have, that is, a certain loss of unity and comprehensiveness. However, the papers are valuable and the presentation, especially the illustrations, is excellent.

GREEN BOOK FOR BUYERS AND SELLERS. *Oil, Paint & Drug Reporter*, New York, 1931. Free with subscription; price otherwise, $2.50.—A new edition of the useful guide to manufacturers and suppliers of chemical raw materials.

PHYSICAL CHEMISTRY FOR COLLEGES. Third edition. By *E. B. Millard*. McGraw-Hill Book Co., New York City, 1931. 522 pages. Price, $3.75.—A modernization of the foundation on which many engineers have built their physical chemical knowledge.

GMELINS HANDBUCH DER ANORGANISCHEN CHEMIE. Iron, Part B, No. 4. Verlag Chemie, G.m.b.H., Berlin, 1931. Pages 657-872. Price (in subscription) 28 M.—Continuation of the section on iron, treating the more complicated compounds, such as the cyanide and silico-chlorides, and the effect of other salts on iron compounds.

SELECTIONS FROM RECENT LITERATURE

EVAPORATING SPENT PULP LIQUORS. F. A. Oetken. *Papier-Fabrikant,* Aug. 16, pp. 545-9. In the evaporation of sulphite and sulphate liquors, particularly of spent sulphite liquor, more progress was made, until recently, in thermal efficiency and corrosion prevention than in solving the troublesome problem of incrustation with gypsum scale. The new Lurgi process, however, has been developed with this difficulty especially in mind. The essential features of the apparatus are a heater, a separator, a control valve, an evaporator, a separator and a pump, with necessary connections for admitting the liquor and hot steam and for withdrawing the residue and condensate. In order to prevent deposition of calcium sulphate, advantage is taken of the fact that supersaturated solutions of this salt can be obtained. The liquor is pumped into the heater, where it is heated only to such a temperature that the limit of metastable supersaturation is not exceeded, meaning by this the limit to which supersaturation may be carried for practical purposes. Thus no solid calcium sulphate is precipitated till after the liquor leaves the heater. The precipitation occurs in the separator, in which the sludge is allowed to settle. Evolution of steam in the heater is prevented by applying to the heater a pressure higher than that of the steam being used. By permitting the calcium sulphate to accumulate in the separator, none is deposited in the heater except for traces which appear when the apparatus is being discharged while hot. This small quantity can be removed, chemically or mechanically, at long intervals and hence gives no trouble. Photographs and drawings of the apparatus are shown, and a comparison is made with the Siemens and Agfil electrical processes.

MAGNESIUM ALLOYS. Walther Schmidt. *Zeitschrift für Elektrochemie,* August-September, pp. 508-17. The industrial development of magnesium alloys, dating back to 1909, has been largely in the automotive field. The very low specific gravity makes these alloys particularly useful in aircraft construction. But there also has been development of corrosion-resisting alloys suitable for chemical equipment. Magnesium is inherently resistant to atmospheric corrosion, because the initial thin film of oxide adheres closely and protects the underlying metal. Unlike aluminum, magnesium in certain of its alloys is inert to alkalis and hydrofluoric acid. All alloy containing 2 per cent of manganese has been found to have high resistance to water corrosion. Untreated alloys are not suitable for prolonged contact with acids or salt solutions; but there is available a heat-treated alloy which is resistant to sea water. There also is a chemical treatment for increasing the corrosion resistance of magnesium alloy surfaces; it makes use of a nitric-acid solution of dichromates of the alkali metals. Manganese is a particularly helpful ingredient for increasing the resistance of magnesium alloys to corrosion; it provides a protective surface film. Tables of physical properties of various commercial alloys are given, and numerous uses are illustrated by photographs.

POROUS HARD-RUBBER EQUIPMENT. H. Danneel. *Korrosion,* Aug. 25, pp. 33-6. Microporous hard rubber is now being made in five grades, having 20, 30, 40, 50, and 60 per cent porosity (per cent of total volume occupied by pores). The pores are so fine as to be invisible to the eye. Uses of this material in chemical equipment depend on the porosity and on the kind of pressure treatment which has been applied (fast or slow, sudden or gradual). Among the principal articles for which microporous hard rubber is suitable are filter plates (for liquids or gases) storage-battery separators, electrolytic diaphragms, centrifuge parts, moving belts for dewatering materials bv absorption, apparatus for treating water or sewage, and apparatus for mixing liquids and gases. The mechanical properties of microporous rubber meet the sometimes exacting requirements for these articles; and the chemical resistance of the material adapts it to many uses in the process industries. Even such corrosive acids as hydrofluoric, sulphuric, and phosphoric affect it only slightly; and it is resistant also to organic acids and strongly oxidizing acids such as chromic acid. Alkali and salt solutions have little or no effect on it; alkali sulphides have a variable but only slight effect. A table of data on the behavior toward corrosive chemicals is given; and a curve chart shows rates of filtration of tap water through microporous hard-rubber sheets.

AMMONIA SYNTHESIS. Giacomo Fauser. *Giornale di Chimica Industriale ed Applicata,* August, pp. 361-7. In order to keep down production costs in ammonia synthesis it is necessary to know the most economical operating pressure, the optimum temperature gradient and the best means of separating ammonia from the product. It has been found that the recovery of the ammonia in liquid form has advantages. The output of a column then varies with the temperature of the available cooling water, and a greater column capacity must be provided to maintain uniform rate of production; but this is largely compensated by thermal advantages and by the fact that the ammonia evaporator is then not needed. Experience indicates that the most economical operating pressure is about 200 atm.; this takes into consideration power consumption and other cost factors. On the basis of the influence of catalyst temperature on the ammonia content of the nitrogen hydrogen mixture, a method has been developed for obtaining the optimum temperature conditions for ammonia synthesis. By this means a notable increase has been effected in the producing capacity of a catalytic column. Drawings are shown of apparatus designed to utilize these and other recent improvements.

DUST SEPARATION. Willy Sell. *Forschungsheft, 347, Verein Deutscher Ingenieure;* Supplement to Forschung auf dem Gebiete des Ingenieurwesens, August; 23 pp. In a comprehensive experimental investigation of mechanical methods of separating dust from gases, two lines of thought were followed. One dealt with optimum shape and arrangement of bodies to be interposed in the dust path; the other dealt with air filters of different kinds, including oil-wetted filters. Among simple intercepting bodies, best results were obtained with a streamlined hollow shape. A photograph shows the paths of dust flow when a number of these shapes are placed in rows, in staggered arrangement, with the hollow faces toward the direction from which the dust flows. Theoretical calculations, based on Stokes' law and the equations of motion for streamline flow, were checked with the experimental results. In the study of air filters, greatest attention was given to the variety of ways in which the gas to be cleaned is forced through sinuous paths formed by metal walls, bent in suitable shapes but held at a suitable spaced interval from adjacent walls. Calculations for this type of filter, and for the type having straight or curved channels containing spaced baffles, were also checked with experimental results. A general equation for air filtration is derived. The work is not conclusive from the engineering standpoint, but is made the basis of recommendations for further study to ascertain the best type of dust separators or filters to be used for cleaning flue gases, dust-laden air, etc. Many photographs, diagrams, and curve charts are shown.

HEAT OF CONDENSATION. E. Kirschbaum. *Chemische Fabrik,* July 1; pp. 287-8. The problem of heat transfer from condensing steam (dry or saturated) is important in equipment design and construction, but there is still considerable difference of opinion as to the relative thermal efficiency of dry and saturated steam when used to supply heat by condensation. From theoretical considerations, superheated steam might be expected to be superior; but observa-

tions made in practical operation have led some to take the opposite opinion. To settle this doubtful point, experimental comparisons have been made in heat exchangers of the straight tube type and of the coil type. In the main, the results indicate that there is little reason to prefer one form of steam over the other in so far as thermal efficiency is concerned. Only in the straight-tube heat exchanger, at high water velocities, was any increase in heat transfer number found for superheated steam; this increase appears as the degree of superheating increases, but is small. At low water velocities, superheated steam shows a slight decrease in heat transfer number as compared with saturated steam. The numerical results of the investigation are shown in curve charts. The conclusion is that there is no essential difference in the heat transfer from condensing steam, depending on whether or not the steam is superheated. It is therefore considered sufficient, in making calculations for heat exchanger design, to set up for superheated steam a heat transfer number and a temperature gradient, both of which are referred, for any given pressure, to the temperature of saturated steam.

CERINI DIALYZERS. Hanns Schmidt. *Chemische Apparatur,* July 10; pp. 145-8. For the recovery of caustic alkali from solutions heavily contaminated with colloidal matter, concentration by evaporation is ineffective, and chemical methods are too costly. The principal commercial occurrence of the problem is in the recovery of spent caustic from the liquors used in the manufacture of alkali cellulose. Colloidal hemi-cellulose, present in these liquors, prevents purification by settling or evaporation. The Cerini system of dialysis was developed in Italy to meet the need for lower production costs in the manufacture of viscose silk and transparent (regenerated cellulose) films. Recovery of spent lye by dialysis, to be commercially profitable, must have simple yet efficient apparatus and long-lived but highly effective semipermeable membranes; and its operation must be largely automatic, without care or supervision. The Cerini apparatus, once started, automatically reaches its equilibrium state and remains there for months at a time; it is necessary only to maintain the supply of spent liquor and water. The osmotic membranes are made of cotton fabric, mercerized according to a prescribed method and specially treated after mercerizing. These are stretched over metal gauze. The density of the recovered caustic can be regulated within a wide range; the optimum operating results are obtained at about 8-10 per cent sodium hydroxide content. Photographs and drawings show plants equipped with Cerini apparatus, and details of the construction of the dialyzer units.

Recent Government Publications

Documents are available at prices indicated from Superintendent of Documents, Government Printing Office, Washington, D. C. Send cash or money order; stamps and personal checks not accepted. When no price is indicated, pamphlet is free and should be ordered from bureau responsible for its issue.

Leather Industry and Trade of France, by Walter Hertz. Bureau of Foreign and Domestic Commerce Trade Information Bulletin 763; 10 cents.

British Leather Goods Industries and Trade, by Leslie T. Portch. Bureau of Foreign and Domestic Commerce Trade Information Bulletin 770; 10 cents.

Textile Chemicals in the United Kingdom, by Wallace E. Moessner. Bureau of Foreign and Domestic Commerce Chemical Division Special Circular 350; mimeographed.

British Explosives Industry in 1930, by Roger R. Townsend. Bureau of Foreign and Domestic Commerce Chemical Division Special Circular 351; mimeographed.

The Spanish Naval Stores Consortium, Its History and Recent Dissolution, by Katherine Elliot. Bureau of Foreign and Domestic Commerce Chemical Division Special Circular 352; mimeographed.

Cleaners, Water Treatment Chemicals, Rust Preventives in Rumania, by John Randolph. Bureau of Foreign and Domestic Commerce Chemical Division Special Circular 345; mimeographed.

Swiss Dye Industry in 1930, by Albert W. Scott. Bureau of Foreign and Domestic Commerce Chemical Division Special Circular 342; mimeographed.

Cement Markets of the Western Hemisphere. Bureau of Foreign and Domestic Commerce Minerals Division Special Circular 1; mimeographed.

Standard Samples Issued or in Preparation. Supplement to Bureau of Standards Circular 25, dated Jan. 15, 1931.

Treating a Complex Ore, by G. L. Oldright. Bureau of Mines Technical Paper 499; 15 cents. Data from experimental work on ores in the Denver Laboratories of the Complex Ores Recovery Co.

Tests on Brick Kilns Fired with a Stoker, by W. E. Rice and R. R. Faller. Bureau of Mines Report of Investigations 3122; mimeographed.

Relationship Between Volatility and Consumption of Lubricating Oils in Internal-Combustion Engines, by Gustav Wade and A. L. Foster. Bureau of Mines Technical Paper 500; 10 cents.

Twenty-third Semi-annual Motor-Gasoline Survey. Issued by the Bureau of Mines in two parts, as follows: Part one, by E. C. Lane, E. L. Garton, and A. J. Kraemer, Report of Investigations 3129; Part Two—Specification Data, by E. C. Lane, Report of Investigations 3142. Mimeographed.

Properties of Typical Crude Oils From the East Texas Field, by E. L. Garton. Bureau of Mines Report of Investigations 3130; mimeographed.

Reduction of Evaporation Losses From Gasoline Bulk-Storage Station Tanks, by Ludwig Schmidt and C. J. Wilhelm. Bureau of Mines Report of Investigations 3138; mimeographed.

Zircon (The Gem), by E. P. Youngman. Bureau of Mines Information Circular 6465; mimeographed.

Bismuth, by Paul M. Tyler. Bureau of Mines Information Circular 6466; mimeographed.

Iceland Spar and Optical Fluorite. by H. Herbert Hughes. Bureau of Mines Report of Investigations 6468; mimeographed.

Quartz and Silica. Issued by the Bureau of Mines in three parts, as follows: Part I—General Summary, by R. M. Santmyers, Information Circular 6472; Part II—Quartz, Quartzite, and Sandstone, by R. M. Santmyers, Information Circular 6473; and Part III—Sand and Miscellaneous Silicas, by R. M. Santmyers, Information Circular 6474. Mimeographed.

Reclaimed Rubber, by A. T. McPherson, Bureau of Standards Circular 393; 10 cents.

Leaching Oxidized Copper Ores: Effect of Strength of Acid in Leaching Solvent, by John D. Sullivan and G. L. Oldright. Bureau of Mines Report of Investigations 3106; mimeographed.

Flotation of Low-Grade Phosphate Ores—II, by H. M. Lawrence and E. Roca. Bureau of Mines Report of Investigations 3105; mimeographed.

Rhenium (and Masurium) by Paul M. Tyler. Bureau of Mines Information Circular 6475; mimeographed.

Chalk, Whiting, and Whiting Substitutes, by Oliver Bowles. Bureau of Mines Information Circular 6482; mimeographed.

1931 Annual Supplement, Survey of Current Business. Bureau of Foreign and Domestic Commerce document; 25 cents. Eight-year summary of many industrial, financial, and commodity statistics compiled by the Bureau (1923 to 1930, inclusive).

Commerce Yearbook, 1931, Vol. I—United States. Department of Commerce document; $1. Contains detailed information concerning business conditions in the United States and its non-contiguous territories and possessions, including statistical information originally collected by numerous government bureaus, trade associations, and trade journals.

General Information for Refiners of Petroleum. Navy Department Bureau of Engineering pamphlet No. 31. Gives information regarding tests of lubricating oils at the Engineering Experiment Station, Annapolis, Md.

Solvents Industry Trade Practice Rules. Federal Trade Commission mimeographed statement.

Medical Gas Industry Trade Practice Rules. Federal Trade Commission mimeographed statement.

Mineral production statistics for 1930—preliminary mimeographed statements from Bureau of Mines on: clay, phosphate rock, mica, tungsten, lime, crude barite and barium products, secondary metals, and portland cement.

Mineral production statistics for 1930—separate pamphlets from Bureau of Mines on: Fluorspar and Cryolite, by Hubert W. Davis, 5 cents; Potash, by A. T. Coons, 5 cents; and Antimony, by Paul M. Tyler, 5 cents.

Federal Specifications. Issued by Federal Standard Stock Catalogue Board, as follows: Iron-hydroxide and iron-oxide paints; ready-mixed and semi-paste black paint; water-resisting spar varnish; coal-tar creosote wood preservative for ties and structural timbers; creosote wood preservative for brush and spray treatment; mono-methyl-paraminophenol sulphate; industrial thermometers; water-resisting red enamel; zinc-chloride wood preservative for ties and structural timbers; granulated insulating cork; corrugated asbestos-copper gaskets; asbestos millboard; diaphragm packing; flax packing, cloth-insertion rubber packing; low-pressure spiral gland packing; titanium-zinc paints, ready-mixed and semi-paste; asphalt varnish; compressed (corkboard) cork; asbestos plaster magnesia; metallic-cloth asbestos sheet packing; asbestos rope and wick packing; hard-fiber sheet packing, raw linseed oil; metallic-cloth asbestos gaskets; molded block magnesia pipe covering; liquid paint drier; putty; shellac varnish; wood-preservative (preservative treatment); boiled linseed oil; olive drab paints, ready-mixed and semi-paste; pigmented nitrate dope; semi-pigmented nitrate dope; ocher, dry, paste in japan, and paste in oil; red lead, dry and paste in oil; gypsum plaster; gypsum plasterboard; volatile mineral spirits paint thinner; turpentine (gum spirits and steam-distilled wood turpentine); interior varnish; spar varnish mixing for aluminum paint, venetian black; and zinc oxide, dry and paste in oil. 5 cents each.

Paint Thinners. Part I—Effect of Different Paint Thinners on the Durability of House Paints in Outdoor Exposure Test, by F. L. Brown. Forest Products Laboratory (Madison, Wis.) mimeographed Report No. 921.

Weights of Various Woods Grown in the United States. Forest Products Laboratory (Madison, Wis.) Technical Note 218.

Chemical Analyses of Wood. Forest Products Laboratory (Madison, Wis.) Technical Note 235.

Nail-Holding Power of American Woods. Forest Products Laboratory (Madison, Wis.) Technical Note 236.

THE PLANT NOTEBOOK

Temperature-Sensitive Paint

By Herbert Chase
Mechanical Engineer
Forest Hills, N. Y.

One of the most useful materials an investigator can have for tests involving temperature is a paint which will change color with changes in temperature, thereby indicating visually the temperature cycle through which the painted surface passes under a given set of conditions. Doubtless, many chemical engineers have wished for an index of this sort without knowing that such paints are available or can be prepared easily. That, at least, was the experience of S. W. Rushmore, of the Rushmore Laboratory, Plainfield, N. J., who, during the course of his extensive experiments on steam cooling systems for automotive engines, sought far and wide for such a paint. After many inquiries he finally discovered that W. S. Andrews, of the General Electric Co., had experimented with such paints; and the present writer recently found that one having the same formula is used in the laboratory of John W. Masury & Son, paint manufacturers of Brooklyn, N. Y.

This paint is made by mixing intimately one part by weight of cuprous iodide with two parts of mercuric iodide, either dry or with the addition of a little water. If water is employed, it must be evaporated by the application of a gentle heat at a temperature below 140 deg. F. When dry, the mixture should be ground to a fine powder, which is then mixed with a thin, light-colored, non-acid oil or spirit varnish. The resulting paint is applied with a brush.

Metals such as tinned iron or brass may be given one or more coats, but the paint should not be applied to aluminum, as the resulting chemical action destroys the paint. A surface covered or striped with this paint—for example, a bearing or machine part—will be bright red from room temperature to 130 deg. F., at which temperature perceptible darkening occurs. At 135 deg. the paint is noticeably darker and at 145 deg. it is maroon. At 155 deg. it assumes a light chocolate color and at 160 deg., dark chocolate. When it has reached 190 deg. it attains the darkest color that can be distinguished, and at 212 deg. it is almost black.

In cooling, the color cycle is reversed, with the exception that the dark chocolate color appears at 170 deg. instead of 160 deg. and temperatures between 212 and 170 deg. are not readily determinable. Below 170 the colors reappear at the temperatures indicated for the ascending scale, and the cycle can be repeated as often as desired. A stripe of the paint on a hot-water tank will show readily the hot-water level.

Two precautions should be observed: The paint should not be heated above 300 deg. F., as decomposition begins at about this point; and if it is used indoors in any considerable quantity on surfaces that become hot, good ventilation should be supplied, as the fumes evolved, especially when the paint is heated while quite fresh, are unpleasant if not harmful. Small quantities, however, serve to indicate temperature quite as well as large quantities do.

Formula for Theoretical Recovery of Coke

By Harold E. Wilson
Inland Steel Co.
East Chicago, Ind.

A practical formula for coke recovery always is valuable in coke plant work, both for calculating production and as a check on production when all the coke has been weighed. The formula derived below has been in use for some time by the Inland Steel Co. It permits the calculation of coke recovery from the wet coal charged to the coke ovens, and has been found to be both accurate and easy to use. It was developed only after inquiries had failed to reveal the existence of a formula which would satisfactorily cover the facts. It requires but one constant which can generally be chosen, once and for all, for each individual plant.

The coke produced from any given quantity of coal will be a composite of three principal factors: fixed carbon and ash in the original coal; volatile matter in the coke; and redeposited carbon in the coke which results from the breakdown of some of the volatile hydrocarbons. This latter is the constant referred to above. It is dependent on the top temperature of the ovens and on the volatile content of the coal. In most plants from 3 to 4 per cent of the coal, as charged, will appear as redeposited carbon in the coke, but abnormally high or low top temperature and volatile content will alter this range. Hence, it should be determined individually for each plant.

For all practical purposes the recovery formula can ignore the volatile content of the redeposited carbon.

Let

W = Weight of *wet* coal as charged
D = Weight of *dry* coal as charged
$100M$ = Per cent of moisture in wet coal
$100\,V$ = Per cent of volatile matter in dry coal
$100\,v$ = Per cent of volatile matter in coke
$100\,R$ = Per cent of redeposited carbon, based on wet coal
$100\,F$ = Per cent coke recovery

Then

$$D = W\,(1 - M)$$

Fixed carbon and ash

$$= D(1 - V) = W(1 - M)\ (1 - V)$$

V.M. in coke

$$= W(1 - V)\ (1 - M)v$$

Hence coke produced

$$= W(1 - M)\ (1 - V) + W(1 - M)\ (1 - V)v + WR$$

And coke produced $= WF$

$$= W[(1 - M)(1 - V)(1 + v) + R] \qquad (1)$$

In cases where the volatile content of the coke is high enough to result in appreciable error from ignoring the volatile in the redeposited carbon, this can be included, yielding the formula:

Coke produced

$$= W[(1 - M)(1 - V) + R]\ \ (1 + v) \qquad (2)$$

As an example of the use of Formula 1, take a coal with 4 per cent moisture and 30 per cent volatile matter on the dry basis, which gives a coke with 1.5 per cent volatile and redeposited carbon of 3.5 per cent on the coal as charged. From Formula 1:

Total dry coke

$$= W\,(1-0.04)\ (1-0.30)\ (1 + 0.015) + 0.035 = 0.717\,W$$

Hence 71.7 per cent of the weight of wet coal charged appears as coke. Ignoring the volatile content of the redeposited carbon in this case gave a yield that was low by $0.035 \times 0.015 = 0.000525$, or only 0.07 per cent.

Calculations necessary for this formula can easily be run off on the slide rule, quite accurately to the third place, since the laboratory analyses usually are carried to the fourth decimal. Furnace coke recovery can easily be obtained from the formula by subtracting the percentage of dry domestic coke and breeze (in terms of the coal charged) from the factor F. If one desires to leave an allowable per cent of moisture in the furnace coke, F can be multiplied by the factor (1+moisture in the coke).

EQUIPMENT NEWS
FROM MAKER AND USER

New Principle in Vacuum Filtration

A DISTINCTLY novel principle in vacuum filter construction has been applied in the new "Genter Type" oscillating continuous vacuum filter which has just been announced by the Bartlett Hayward Co., Baltimore, Md. In its simplest form the filter consists of a trough containing the material to be filtered, in which a spider rotates on a horizontal shaft, carrying on its periphery a number of tubular, cantilever filter elements. Fig. 1 illustrates this type, which is known as the "Single" unit. Rotation of the spider is clockwise, but the rotation is not continuous, being rather an interrupted oscillating movement which carries the filter elements progressively forward, although their travel is alternately in opposite directions.

This oscillation of the elements serves to agitate the slurry in the tank, where each element travels a much greater distance while submerged than would an element of a conventional filter. Nevertheless, while the speed of movement is much higher than with the conventional filter, elements remain beneath the surface equally long. These features are said to eliminate all tendency for the solids to segregate, and to prevent the finer material from depositing first on the filter envelope and decreasing the filtering rate. They also make possible more rapid submergence of the elements and permit the use of a shallow tank which insures the maximum drying arc.

Discharge of the cake is effected by the use of either atmospheric or low-pressure air which is applied by the port valve used to control the application of vacuum to the several elements. Removal is assisted by the oscillation of the discharging element between scrapers supported over the discharge hopper. The scrapers do not, however, touch the filter envelope. The oscillation also causes the air pressure to pulsate, further assisting the removal of the solids.

Fig. 1—Oscillating Continuous Filter With 20 Tubes and 20 Sq.Ft. of Area

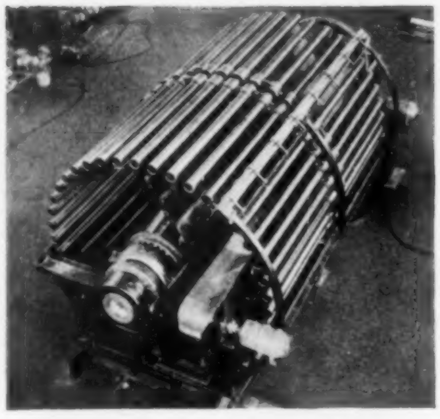


Fig. 2—Twin Oscillating Continuous Filter With 80 Tubes and 700 Sq.Ft. of Area

Two types of filter for larger operations have also been designed. One of these is shown in Fig. 2. This is called the "Twin" unit and consists of a single spider and a single tank with cantilever filter elements extending from both sides of the spider. The third type, known as the "Double" unit, consists of two single-end units installed on a single shaft in a divided tank. Its purpose is the filtering of two different materials, or the filtering, repulping, and refiltering of the same material.

Any one of these three types can be supplied with a shield and sprays for washing the solids on the filter. The two larger types are provided with a discharge hopper and belt conveyor mounted eccentrically lengthwise within the filter cage. Filter envelopes of any material may be used and are said to be easily installed while the filter is in operation. It is only necessary to slip the envelope over the cantilever element and fasten it at both ends.

Filters of this construction are said to operate successfully without recirculating overflow on all types of material now being handled with continuous vacuum filters. They are said to produce a more uniform cake with lower moisture, less wash water, greater capacity per unit of filtering area, and less labor and maintenance cost per unit of output.

The makers are prepared to supply the oscillating continuous filter in standard sizes and types ranging from 24 to 96 filter elements with from 125 to 1,000 sq.ft. of filtering area. The machines occupy a floor space ranging from 9 ft. 8¾ in. x 7 ft. 7 in. in the smallest size to 25 ft. 8½ in. x 13 ft. 7 in. in the largest, and are powered with motors of from 2 to 15 hp.

Straight-Plug Valve

A LUBRICATED straight cylindrical plug, instead of a tapered plug, and the elimination of packing and gaskets are important features of a new line of "A.C.F." Milliken valves recently brought out by the American Car & Foundry Co., 30 Church St., New York. These valves are available in sizes from 1 to 8 in. and for pressures from 125 to 250 lb. A Venturi type is supplied for pressures to 500 lb. These valves are obtainable in both screwed and flanged models. Various materials of construction may be used, depending on the service. The manufacturer points out that straight plugs are interchangeable without the necessity of grinding.

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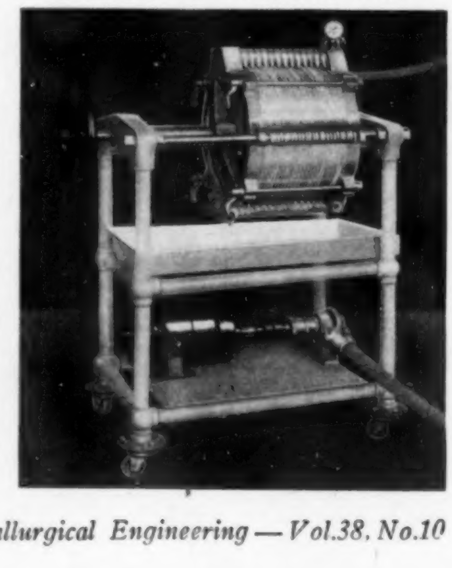
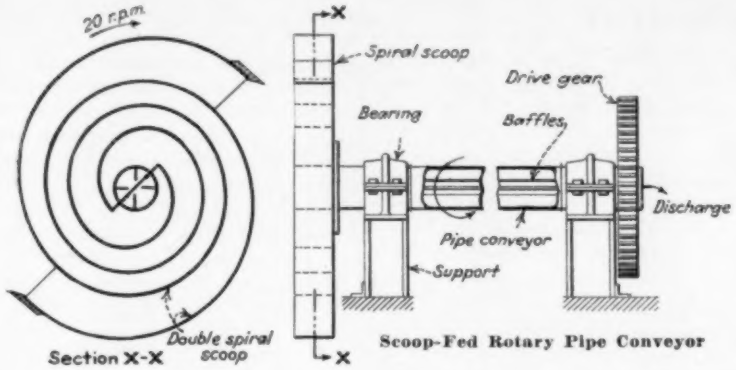
Asbestos Clarifying Filter

PRODUCTION of a wide variety of crystal-clear products is said to be possible with a new asbestos-disk clarifying filter, recently announced by the Alsop Engineering Corp., 39 West 60th St., New York City. The filter media are specially prepared asbestos disks about ¼ in. thick which are clamped between plates of a metal suitable for the intended service. These filters are made in sizes varying from a bench model for experimental purposes, containing only two disks, to a large production size, using up to 100 disks. Smaller models are supported in an overhung position and the larger models are built like a filter press with the end castings and intermediate plates supported on side bars. All filters are portable and are provided with a motor-driven pressure pump, pressure gage, and supporting framework. The manufacturer will supply various grades of filter disk.

Production Model Clarifying Filter





Scoop-Fed Rotary Pipe Conveyor

Rotary Pipe Conveyor

ARRANGEMENTS have been completed by the Dorr Co., 247 Park Ave., New York City, whereby this company will manufacture a rotary pipe conveyor developed by E. W. Davis. This conveyor, the construction of which is illustrated in the accompanying sketch, consists of a section of horizontal pipe supported on plain bearings and carrying at one end a drive gear and at the other end a spiral scoop. The conveyor is designed for handling suspensions containing solids which tend to settle. To prevent settling and to insure travel of the solids through the tube, four angle-iron agitator ribs are placed longitudinally inside the pipe.

Material is elevated and fed to the pipe by the rotation of the scoop. This device supplies sufficient head to force pulp through the pipe. Discharge may be at either or both ends or at any number of intermediate points. Several scoops at different points may be provided if necessary. The conveyor is intended particularly for handling and distributing pulp in closed-circuit grinding hook-ups, where gravity distribution is not sufficient. Among its uses are the conveying and distributing of feeds from grinding mills to wide classifiers; feeding classifiers of any width where loss of head is to be avoided; feeding bowl classifiers in closed circuit; and feeding mills of various sorts.

Electrical Developments

RECENT DEVELOPMENTS of the General Electric Co., Schenectady, N. Y., include a new solenoid-operated valve, Type CR-9507-A1, which is intended for the control of gases and liquids under pressure. Valves are of the unbalanced type and require very little power for operation. The design is such that a wide seat is obtained, giving long life and reliable operation, according to the manufacturer. Among advantages, the company points to the fact that the operating coils are designed for continuous duty; the valve seat can be ground without removing the valve from the line; the gland is of the rotary type, giving little wear and friction; and wearing parts are a minimum in number.

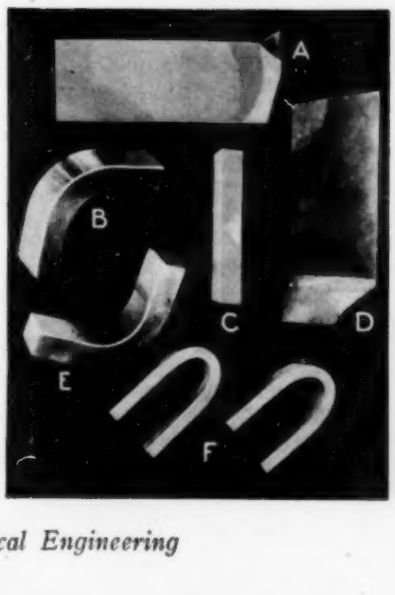
A second product is a new time switch, consisting of a Telechron motor operating mercury-to-mercury switches which are capable of carrying alternating current of 115 volts and 30 amp. or 230 volts and 15 amp. Two adjustable riders on the timing dial are capable of starting and stopping two operations every 24 hours. Special astronomic dials are available, corrected for latitude in different parts of the country. This feature makes allowance for geographical location and the season of the year and permits the performance of certain operations with regard to the movements of the sun. The switch is intended for turning on and off lights, controlling heating devices, and starting and stopping other equipment.

Composite Alloy Steel

EXPENSE of the high-nickel-chromium-iron alloys and chrome irons has sometimes stood in the way of their utilization. To avoid high cost, Industrial Welded Alloys, Inc., 225 Broadway, New York City, undertook research which has culminated in the perfection of a composite metal which has been named "Plykrome." The base of this metal is mild steel, and the corrosion-resisting surface any of the high-chrome and high-chrome-nickel-iron alloys it may be desired to use. The material is made by the use of a special welding process in which a plate of the alloy, of predetermined thickness, is welded to the steel slab or billet. This is then rolled in accordance with usual mill practice into plates, bars, sheets, and other forms.

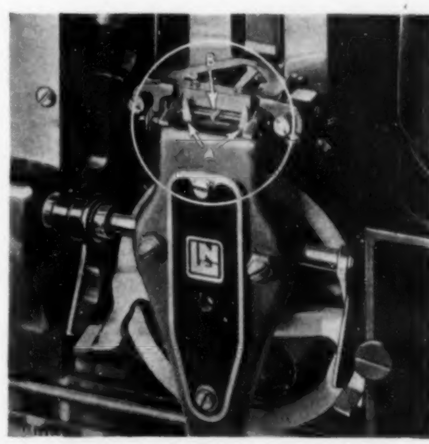
Tests Show Perfect Adherence of Plykrome's Alloy Veneer

(A) 18-Ga. Double-Surfaced Sheet With Steel Core Eaten Away; (B and E) 90-Deg. Cold-Bend Tests With Alloy Plies Respectively on Outer and Inner Surfaces; (C) Typical Fabrication Weld; (D) 20-Ga. Single-Surfaced Sheet, Steel Backing Eaten Away; (E) 180-Deg. Cold-Bend Tests With Alloy Plies on Inner and Outer Surfaces.



Fabrication of Plykrome is to be carried out exclusively at the company's plant. Welding processes used will include recognized practice in the welding of mild steel, together with a special arc process developed by the company for the joining of the various chrome-nickel steels.

Any desired ratio of thickness of alloy to backing sheet can be produced. It is present practice to recommend a ratio of approximately 1 to 15, but for very heavy pressure vessels the ratio may be increased up to 1 to 30. Considerable strength increase results from the veneering, as, for example, where the addition of alloy increases the plate thickness by 7 per cent and the ultimate strength by 25 per cent. In most cases the alloy veneer is applied to only one side of the mild steel; however, it may be applied to both sides. Tests have indicated that the composite metal can be handled, bent, drawn, spun, or flanged by methods usual with ordinary steel and without cracking or parting the components. The company declares that the bond is perfect and the veneer completely inseparable.



Potentiometer Pyrometer Using Micromax Balancing Unit

Improved Potentiometer Pyrometer

INTRODUCTION of an improved form of its potentiometer pyrometer has been made by the Leeds & Northrup Co., Philadelphia, Pa. The improved instrument has been given the name of "Micromax" to distinguish it from the earlier instrument made by this company. There are two principal improvements. One is the addition of an automatic standardizing device which, every 45 min. or more frequently, standardizes the potentiometer circuit more accurately, it is declared, than is possible by hand. The second improvement, shown in the accompanying halftone, consists in a more sensitive

mechanical method for balancing the circuit.

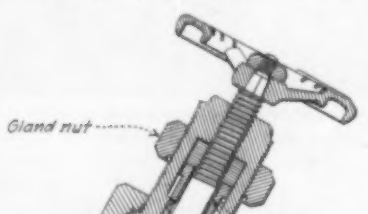
At frequent intervals the scissors levers A move toward each other and intercept the galvanometer pointer B. Should the pointer, indicating an unbalanced galvanometer, be found either side of the center, the balancing mechanism is rotated in one direction or the other. This method eliminates all operating clearance between the galvanometer pointer and the levers, making possible the detection and recording of pointer deflections as small as 0.001 in. This device also has increased the speed and ruggedness of the instrument, with coincident improvement in accuracy. It is reported that the recording pen can step across the entire calibrated chart in less than 22 seconds. The company states that these improvements may be applied to the L & N recorders now in operation.

Pressed-Steel Sheave

To MEET the demand for a lightweight, low-priced drive, Allis-Chalmers Mfg. Co., Milwaukee, Wis., has developed a pressed-steel sheave for multiple V-belt drives, which is being sold under the name of "Texsteel." These sheaves, together with Texrope drives, are available from stock for immediate delivery. They are die-pressed and welded and are said to eliminate vibration and noise and have accurate balance. They are manufactured in a large range of diameters, permitting ratios as high as 6 to 1.

Forged Steel Valves

CHOICE of Stainless steel or Nitralloy seats and disks is a feature of a new line of forged-steel globe, angle, and check valves which is being offered by the Chapman Valve Mfg. Co., Indian Orchard, Mass. The globe valves, one of which is illustrated in the accompanying sketch, are of the

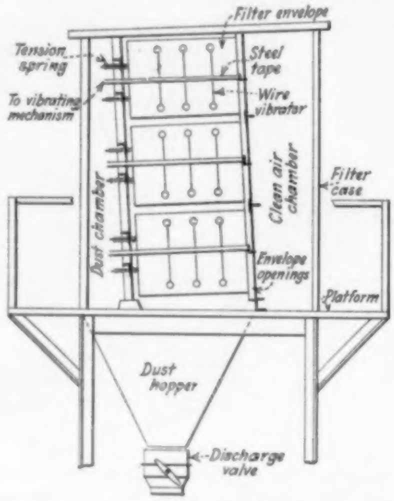


Forged-Steel Globe Valve

60-deg. angle-stem type. Angle valves have passages at 90 deg. The body material is chrome-tungsten steel. Disks are supplied both in the swivel type, as illustrated, and in an integral plug form. These valves are made with screwed ends and flanged or union bonnets, in sizes from $\frac{1}{4}$ to 2 in., and for pressures from 600 to 1,500 lb.

New Dust Filter

AN IMPROVED form of dust filter for removing many types of dust from air has been developed by the W. W. Sly Mfg. Co., Crain Ave., Cleveland, Ohio. The new filter unit has been designed to fit into the older dust-arrester case made by this company and to provide an additional amount of filtering surface, or the same amount of fil-



Section of Filter Showing Envelope Vibrators and Tension Springs

tering surface with a classifier ahead of the filtering unit. The classifier consists of a baffled chamber for the precipitation of some of the heavier particles of dust.

A complete filter is built up of a number of flat, oblong filter envelopes which are supported with their open ends at the clean-air side of the filter. They are clamped to the framework at the open ends and supported by tension springs at the closed ends. It is asserted that keeping the envelopes under tension increases their life and improves cleaning. The cleaning means consist of a number of wire vibrators supported on steel tapes between the envelopes. When the tapes are vibrated the vibrators lightly tap the envelopes and discharge the dust into the hoppers beneath.

Filters may be made up of sections either 2 or 3 ft. wide and either two or three envelopes high. The company states that the new filter provides greater efficiency, longer life, and lower operating cost, together with positive dust collection.

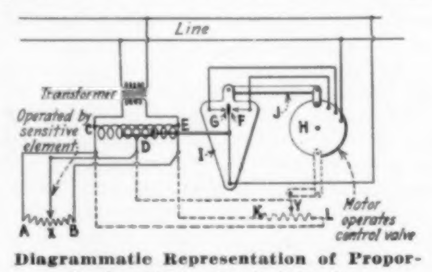
H_2S Generator

INDUSTRIAL plants and educational institutions requiring considerable quantities of hydrogen sulphide can meet their needs with a new generator recently introduced by the General Ceramics Co., 71 West 35th St., New York City. The generator consists of a vertical chemical stoneware column inclosed at the top and supplied with a false bottom. A separate acid container should be placed behind the generator at a height of about 18 in. In operation, about 200 lb. of ferrous sulphide lumps is placed on the false bottom. Acid of proper dilution is put in the acid container and flows down into the generator beneath the porous plate and up through the sulphide. Hydrogen sulphide is evolved as long as it is permitted to escape from the generator. When the discharge valve is closed, pressure of the gas forces the acid down through the false bottom and stops the gas evolution. The generator is so designed that it may be easily cleaned and supplied with fresh material.

Electric Proportioning Control

FOR CONTROLLING temperature, pressure, humidity, liquid level, flow, speed rates, and other variable functions by motor-operated valves and other devices, Minneapolis-Honeywell Regulator Co., Minneapolis, Minn., has developed an electric control system which causes the motor-operated device to move in amount proportional to the change in the variable. The system makes use of an electrical transmission, essentially a Wheatstone bridge, which controls the motor-operated device. How this is accomplished is indicated diagrammatically in the accompanying sketch.

The sensitive device (temperature element, pressure gage, etc.) moves a contact X on the resistance AB. The solenoid CDE contains an iron plunger which seeks a position depending on the location of X, being centered when AX equals XB, and moving proportionately to the movements of X. Hence displacement of X will cause F to close



Diagrammatic Representation of Proportioning Motor Control System

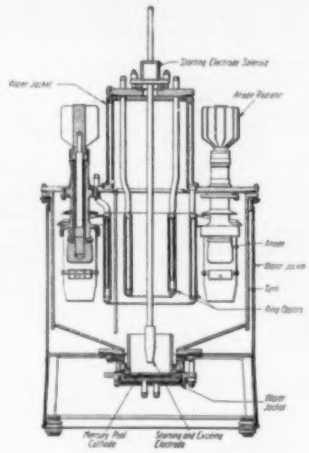
with one or the other of the contacts G. This will start the reversing motor H in the direction which will move the platen I through link J, so as to break the contact. Hence rotation of the motor and movement of the connected valve or damper will be exactly proportional to the movement of X and hence to the change in the variable.

Where it is desired to dissociate the contacts F and G from the motor, the company has devised a system (see dotted lines) whereby the rotation of the motor moves the contact Y of an auxiliary resistance KL, connected in parallel with AB, so as to rebalance the bridge and stop the motor without use of a movable platen I and link J.

The method described is said to be highly sensitive and accurate and to avoid "hunting" of the controller. It is said to be applicable both to large motors and to the small self-contained proportioning motor-control valve combinations offered by the company.

Mercury Arc Rectifier

A NEW steel-tank mercury-arc rectifier for producing direct current for electrochemical processes and other purposes has recently been announced by the Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa. The rectifier, which is shown in the accompanying sketch, operates by virtue of the fact that in an ionized gas (mercury vapor) only a small *positive* potential with respect to the gas is required to cause current to flow to an electrode, although a large *negative* potential must be applied before appreciable current will flow.



Cross-Section of 500-Kw. Rectifier Unit

The rectifier, as will be observed from the illustration, consists of a water-jacketed, gas-tight container from which the air has been removed. This contains six solid electrodes to serve as anodes, and a liquid mercury cathode. An arc is first struck between the starting electrode and the mercury, whereupon mercury vaporizes, rises, and is condensed and returned to the cathode by means of the water-cooled surfaces. Once mercury vapor is present, the starting electrode is withdrawn and de-energized, and the carbon anodes take up the load. The anodes are so connected into the secondary winding of a 3-phase transformer that pairs of them operate simultaneously in transmitting the unidirectional current.

Beside the equipment shown, the rectifier also requires auxiliary devices, including a mercury-vapor pump, for preserving the vacuum, a rotary pump and various control devices operating to remove gases evacuated by the mercury pump, together with equipment for controlling the flow of cooling water. The company is prepared to supply rectifiers in any size necessary for the operations with which they are to be used.

Impregnating Centrifuge

A NUMBER of new uses for centrifuges have been developed in recent months by the Leon J. Barrett Co., Worcester, Mass. These uses involve the application of a centrifuge of standard construction, except for the bowl, which is specially adapted to the type of operation carried on. Using a solid bowl, this company has found that it is possible to impregnate various objects such as coils in a much shorter time than is normally possible. In one case it was found that coils, which ordinarily required 6 hours, were treated by the centrifugal method in 6 minutes with equal effectiveness. The method is based on the fact that a considerable hydrostatic pressure, dependent on the bowl diameter and the velocity, is developed at points near the periphery. Pressure on the object being impregnated can be controlled by controlling its radius of rotation. A special means of support has been used to permit controlled sway about a vertical axis. This oscillating movement, caused by unequal distribution of the load, is made to do useful work in causing a pulsating pressure on the material undergoing treatment, which substantially increases the penetrating effect.

Another variation of this machine is used in the very rapid application of enamels, paints, lacquers, and other coatings to articles which are placed in the basket. Excess coating material is immediately thrown off.

Water-Level Indicator

WATER LEVEL in boilers and tanks may be indicated at any number of points by means of a new system announced by Schutte & Koerting Co., Philadelphia, Pa. This system makes use of a transmitter cylinder which is connected top and bottom to the tank or boiler. Within the transmitter are a number of electrodes which make electrical contact with the water at different heights. Electrodes are connected through relays to a number of indicating lights which show the level of the water. The current passed through the water is low-voltage alternating current from a transformer, so that the possibility of electrolytic decomposition is eliminated. The indicating instrument consists of two parallel rows of lights, one row placed behind a green and one behind a red glass. Light transmitted through the glasses is then viewed through a prism, so that the net effect is to show a two-colored column with the boundary between the red and the green representing the liquid level.

Differential Steam Traps

IN THE DESIGN of thermostatic steam traps, it has been customary to provide for the discharge of condensate at a water temperature of 1 or 2 deg. below the temperature corresponding to the steam pressure. The C. J. Tagliabue Mfg. Co., Park & Nostrand Aves., Brooklyn, N. Y., claims increased efficiency for a new trap which it has recently introduced, by virtue of the fact that the trap is adjustable for discharge at temperatures corresponding to a pressure differential of from 0 to 20 lb. below the operating steam pressure. This adjustment consists of an externally regulatable spring placed within the thermostatic bellows. When tension is removed from the spring, the trap will discharge condensate at from 1 to 2 deg. below the temperature of the operating steam. When tension is applied to the spring, its pressure aids the vapor pressure developed within the bellows in closing the valve. The magnitude of the spring pressure determines the differential temperature at which the trap will discharge. This differential is said to remain constant for any setting, regardless of the pressure under which the trap is operating.

Other features of the trap include reversible, renewable Monel seats and disks, and sturdy and compact construction. The trap is made only of the 1 in. size and is offered by the manufacturers on the basis of 30 days' trial.

Acid-Proof Packing

"SUPER-CUTNO" is the name of a new packing which has been developed by Greene, Tweed & Co., 109 Duane St., New York City, for service with sulphuric, nitric, and other highly corrosive acids. This packing consists of asbestos lubricated with a compound which is said to resist the action of acids, even at high temperatures. The manufacturers state that the compound is retained in the packing as long as possible, in order to prevent the packing from hardening and scoring the pump shaft. Samples may be obtained from the manufacturers on request.

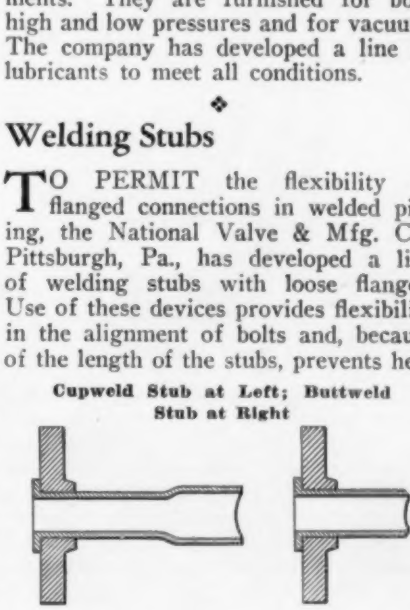
Lubricated Plug Valves

FOR SERVICE with oil, gas, water, and other industrial fluids, the Walworth Co., Statler Bldg., Boston, Mass., has developed a new line of lubricated plug valves, basic patents for which have been acquired by this company. The valves are available in practically all types and sizes and in metals suited to the service requirements. They are furnished for both high and low pressures and for vacuum. The company has developed a line of lubricants to meet all conditions.

Welding Stubs

TO PERMIT the flexibility of flanged connections in welded piping, the National Valve & Mfg. Co., Pittsburgh, Pa., has developed a line of welding stubs with loose flanges. Use of these devices provides flexibility in the alignment of bolts and, because of the length of the stubs, prevents heat

Cupweld Stub at Left; Buttweld Stub at Right



distortion of the flange face during welding. They are made in two designs, as shown in the drawing, one being known as the "Cupweld" stub and the other as the "Buttweld" stub. Both types are obtainable for pipe sizes ranging from ½ to 24 in.

New Hose Masks

IMPROVEMENT in its line of hose masks, to which air is supplied by hand- or motor-driven blowers, has been announced by the Mine Safety Appliances Co., Pittsburgh, Pa. The masks are of the new Kops type which cover the entire face and present only rubber to the action of corrosive gases. The outfit consists of a trunk containing a ball-bearing motor- or hand-operated blower, and one or more hoses and masks. Blowers are available capable of supplying air for from one to six masks.

Light-Sensitive Cell

HIGH current-carrying capacity is inherent in a new photo-electric cell introduced under the name of the "Radiovisor Bridge" by the Burgess Battery Co., 295 Madison Ave., New York City. The new cell consists of a tall glass tube containing a plate of glass upon the front side of which are two interlocking comb-like electrodes of gold, fused in place. These electrodes are covered over by a thin layer of selenium-like enamel, the conductivity of which changes with the amount of light falling on it. For many applications, this cell eliminates the use of vacuum tubes, as it can operate a relay directly. Its maximum wattage rating is 0.15 watt. These cells are said to be adapted to all the usual applications of photo-electric cells, such as automatic counting, color-matching, building lighting control, and so on.

New Screen Mounting

VIBRATING SCREENS ordinarily are balanced with springs, designed to hold the screen body at the proper screening angle. A new mounting designed by the Stephens-Adamson Mfg. Co., Aurora, Ill., consists of a single mechanical unit known as a "Stabilizer" which operates without springs. This is mounted on one side of the screen, permitting the screen body to vibrate freely with the eccentric drive shaft, but avoiding any possibility of its rocking or bouncing on account of sudden surges of material over the screen. Loosening two bolts on one side of the screen permits easy changing of the screening angle. The device consists of a system of links so constructed that the normal motion of the screen is not inhibited, although tipping is absolutely prevented.

Manufacturers' Latest Publications

Balances. Heusser Instrument Mfg. Co., 165 Pierpont Ave., Salt Lake City, Utah.—Bulletin 27—4-page folder describing the line of chain-poise, variable-weight balances made by this company.

Bearings. New Departure Mfg. Co., Bristol, Conn.—Pocket booklet listing dimensions, load data, and list prices on several types of ball bearings, including data on selection, mounting, and other useful information.

Blowers. International-Stacey Corp., Columbus, Ohio.—New Bulletins 22-B-10, 23-B-10, 32-B-10, and 33-B-10, describing the line of standard and heavy-duty blowers and gas pumps made by the Roots-Connersville-Wilbraham Division of this company.

Brake Linings. Garlock Packing Co., Palmyra, N. Y.—Folder describing and listing prices on the new "701" industrial brake lining offered by this company.

Chemicals. Commercial Solvents Corp., Terre Haute, Ind.—7 pages on properties and uses of normal butyl lactate.

Chemicals. Roessler & Hasslacher Chemical Co., 350 Fifth Ave., New York City—Revised edition of 13-page booklet entitled "Vat Colors and Their Oxidation"; also a new 38-page book on properties, uses, and industrial applications of the solvent, trichlorethylene.

Disintegration. Babcock & Wilcox Co., 85 Liberty St., New York City—Bulletin 906—Describes and illustrates this company's new Type C pulverizer for coal.

Dryers. C. O. Bartlett & Snow Co., Cleveland, Ohio.—Bulletin 69—Well-illustrated 31-page booklet on rotary dryers.

Dust Collection. Dust Recovery, Inc., 15 Park Row, New York City—15-page book describing the "Vorticose" screenless dust collector made by this company.

Economizers. Babcock & Wilcox Co., 85 Liberty St., New York City—Bulletin describing forged steel, return-bend-type economizers made by this company.

Electrical Equipment. Century Electric Co., 1806 Pine St., St. Louis, Mo.—Folder describing repulsion-start induction motors.

Electrical Equipment. Crouse-Hinds Co., Syracuse, N. Y.—Bulletin 2235—8 pages on vaporproof industrial lighting fixtures.

Electrical Equipment. General Electric Co., Schenectady, N. Y.—Publications as follows: GEA-67B, float switches; GEA-137B, low-speed synchronous motors; GEA-246C, general-purpose synchronous motors; GEA-318D, insulator units for outdoor devices; GEA-560B, constant-speed, single-phase motors; GEA-708B, "7600 Series" synchronous motors; GEA-720B, direct-current high-speed circuit breakers; GEA-721A, indoor bus supports; GEA-938B, switchgear accessories; GEA-995B, 40 pages on arc welding in industry; GEA-1184A, magnetic switch; GEA-1389, oil-blast explosion chambers in switchgear; GEA-1404, directional distance relay; GEA-1406, explosion-proof, single-phase motors; GEA-1420, time meters; GEA-1429, 24-pages on plastics; GEA-1430, air circuit breakers; GEA-1435, blast gates; GEA-1440, arc welders; GEA-1441, 48-pages on electric equipment for oil refineries; GEA-1448, automatic supervisory equipment; GEA-1449, oil-blast baffle; GEA-1450, mechanical-drive turbines; GEA-1456, cold-molded Cetec; GEA-1457, Textolite molded; GEA-1458, Textolite laminated; GEA-1475, single-phase vertical motors; GEA-1477, arc welder characteristics; GEA-1483, medium-speed a.c. generators; GES-699, G.E. thrustors.

Emulsions. Glyco Products Co., Bush Terminal Bldg. No. 5, Brooklyn, N. Y.—8-page booklet describing methods of making emulsions and giving actual working formulas.

Equipment. Foster Wheeler Corp., 165 Broadway, New York City—55-page book, highly illustrated, showing petroleum refining equipment installed by this company.

Equipment. Guyton & Cumfer Mfg. Co., 4441 Fillmore St., Chicago, Ill.—30-page book describing and listing data on steam-jacketed pumps, valves and fittings, and flanges for assembling double-walled pipe.

Equipment. J. E. Lonergan Co., 211 Race St., Philadelphia, Pa.—92-page illustrated catalog on power plant specialties, including such items as valves and gages of various sorts, lubricating specialties, etc.

Equipment. H. O. Swoboda, Inc., 3400 Forbes St., Oakland Sta., Pittsburgh, Pa.—Bulletin 230—8 pages describing electrically-heated melting and coating tanks.

Equipment. Harold E. Trent Co., 618 No. 54th St., Philadelphia, Pa.—Bulletin TC-11—8 pages on electric melting pots and other electrically-heated industrial equipment made by this company.

Equipment. Wyrick Engineering Co., Wyandotte, Mich.—Bulletin 102—Folder describing equipment made by this company for preserving, both automatically and manually, the correct adjustment of bearings.

Feeders. Deister Concentrator Co., Fort Wayne, Ind.—Sheet DFW-17—Leaflet describing this company's new Concenco disk feeder for crushed and ground materials.

Gears. Earle Gear & Machine Co., 4707 Stenton Ave., Philadelphia, Pa.—Catalog 31—100-page pocket book on metallic and non-metallic gears; also on racks, sprockets, sheaves, and speed reducers.

Gears. Lukenweld, Inc., Coatesville, Pa.—8-page booklet describing the production and advantages of cut gears machined from the welded steel blanks made by this company.

Hydraulic Tables. Baldwin-Southwark Corp., Philadelphia, Pa.—Bulletin 25—32-page book including much engineering data, with emphasis on hydraulics. Contains many useful tables, some of which have never been published before. One of these gives flow of water through pipes for many pipe sizes, and for the three standard pipe weights, for a large range of pressure differentials.

Instruments. Brown Instrument Co., Philadelphia, Pa.—16-page booklet briefly illustrating and describing the principal features of this company's new potentiometer pyrometer.

Instruments. Esterline-Angus Co., Indianapolis, Ind.—Bulletin 931—Describes a new line of flush-type graphic instruments for various electrical measurements.

Instruments. C. J. Tagliabue Mfg. Co., Park & Nostrand Aves., Brooklyn, N. Y.—Catalog 1,000—General catalog of instruments for indicating, recording and controlling functions such as temperature, pressure, liquid level, etc.; 104 pages. Also Catalog 1020, 16 pages describing a new line of flow-measuring, recording, and controlling equipment made by this company.

Insulation. Cork Insulation Co., 154 Nassau St., New York City—40-page catalog on cork insulation for various purposes, including cork board and molded insulation for piping.

MgO Ceramic. American Lava Corp., Chattanooga, Tenn.—24-page catalog describing the wide range of ceramic shapes this company is prepared to supply for electrical-insulating and heat-resisting service.

Metals and Alloys. Universal Oil Products Co., 310 S. Michigan Ave., Chicago, Ill.—Reprint of an article entitled "Safety and Cost Chief Factors in Considering Alloy Steels for Cracking Equipment."

Microscopes. Bausch & Lomb Optical **Co., Rochester, N. Y.**—Folder describing a new binocular microscope, type GSE; and a new inclined binocular body tube.

Mortars. General Refractories Co., 106 So. 16th St., Philadelphia, Pa.—16-page booklet on high-temperature mortars and plastic chrome ore.

Odorization. Pacific Pipe & Supply Co., 1102 Santa Fe Ave., Los Angeles, Calif.—Bulletin O-2—Complete description and prices on the "Papico" natural gas odorization system.

Oxygen. Gas Industries Co., Franklin Savings & Trust Bldg., Pittsburgh, Pa.—Folder briefly describing equipment for oxygen production supplied by this company.

Pumps. DeLaval Steam Turbine Co., Trenton, N. J.—Catalog B-2—12 pages on single-stage, double-suction centrifugal pumps.

Pumps. Taber Pump Co., 288 Elm St., Buffalo, N. Y.—Bulletin SS-629—4 pages on standard sump pumps; also Bulletin G-631, 11 pages with engineering data on single-suction centrifugal pumps.

Raw Materials. Missouri Pacific Railroad Co., Industrial Development Dept., St. Louis, Mo.—Revised map showing location of vegetable and mineral raw materials for chemical processes along the lines and connections of the M.P.R.R.

Rust Prevention. Parker Rust-Proof Co., Detroit, Mich.—Handsome 29-page book describing the Parkerizing process for iron and steel and listing users and jobbing service plants.

NEWS *of the* INDUSTRY

Chemical Trade Favors Six-Hour Day

THE executive committee of the Manufacturing Chemists' Association has recommended that the industry adopt a six-hour day as a means of giving employment to a larger number of workers. Upon this announcement *Chem. & Met.* in conjunction with *The Business Week* ascertained the views of some of the important executives in the chemical industry and found the proposal had met with widespread approval. W. D. Huntington, vice-president of the Davison Chemical Co., stated that he had assurance from a number of companies in the chemical industry that they were putting the six-hour plan into effect. He also stated the plan would be adopted by his company with indications that companies outside the chemical industry would adopt it as rapidly as possible.

Lammot du Pont, president of E. I. du Pont de Nemours, expressed his approval of the plan and said it had been put into effect in several of the du Pont plants and would be extended to all plants where practicable.

Dow Chemical Co. answered that it had advocated the plan for many months and had operated on a seven-hour day since the first of the year with shift men partly on six-hours.

R. H. Dunham, president of Hercules Powder Co., said he had not studied the matter sufficiently but added that for some time his company had followed the policy of spreading employment by short-time operations.

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International Authorities At Coal Conference

ALMOST 100 names are included in the list of speakers who will deliver addresses at the Third International Conference on Bituminous Coal to be held at Carnegie Institute of Technology, Pittsburgh, Pa., Nov. 16-21.

Seventeen countries will be represented in the conference, and an attendance of well over 2,000 persons is expected. The plight of the coal industry has added impetus to the meeting, and the organizers feel that the conference comes at an appropriate time.

The program, divided into sections, will include papers on cleaning and preparation, hydrogenation - classification, byproducts, fertilizer, carbonization, gasification, combustion, pulverized coal, coal and coke, railway and steamship fuel, smoke abatement, dust removal, competition with other fuels, economics, metallurgy, and stream pollution.

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A.W.S. Discusses Pipe and Structural Welding

UNDER the efficient auspices of its Boston section, the fall meeting of the American Welding Society, Sept. 21 to 25, came to a very successful consummation. In collaboration with the American Society for Steel Treating, which held a simultaneous Boston meeting, the Welding Society participated in a broadly instructive exposition, featuring many cutting and welding exhibits.

One of the most important phases of the sessions was the presentation of the report of the Structural Steel Welding Committee, the culmination of five years of work which is expected to do much for the use of welding in building construction. Papers by Everett Chapman, on "Maximum Stress," in its relation to cost and service life of structures; by R. A. Weinman, on the "Fatigue Properties of Welds"; and by C. H. Jennings, on the "Relief of Welding Strains by Annealing," did much to advance welding theory and practice. The papers of F. J. Maeurer, H. V. Inskeep, and I. T. Hook and M. Powell, covering respectively welding of piping and fittings, welding of copper and brass piping, and welding of large Everdur vessels, gave much information of practical engineering value.

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Annual Dye Census to Be Discontinued

PUBLICATION of the Tariff Commission's census of dyes and other synthetic organic chemicals will be discontinued. Ostensibly due to economy, this action is attributed to fear of criticism that the annual review is equally if not more beneficial to foreign competitors. It is reported that domestic manufacturers are divided on the advisability of continuing the survey. The last vestige of authority under which the commission inaugurated the census disappeared long ago. The revenue act of 1916 provided that duties then assessed on dyes would be removed in five years if domestic production had not reached 60 per cent of consumption. To check up the progress of the industry, President Wilson authorized the survey.

R. W. Gallagher Elected Head Of Gas Association

THE American Gas Association held its annual convention and exhibition of equipment and appliances at the Atlantic City Auditorium on Oct. 12 to 16, with somewhat reduced numbers in attendance, but with exhibits rivaling in number and scope any previous convention. Although conscious of restricted general business, the industry learned with satisfaction that 1931 sales of gas have thus far been almost equal to those of 1930; and that gross income has declined in 1930 from the record year of 1929 less than one per cent.

Other official statistics of A.G.A. show a decided further trend from water gas, and retort coal gas to natural gas and, in lesser measure, to byproduct coke-oven gas. Larger quantities of this oven gas are being purchased from steel-plant and merchant-coke-plant producers, but some increase in production by distributing utility companies also was noted.

Election of officers of the association for the coming year placed in the presidency R. W. Gallagher, president of East Ohio Gas Co., Cleveland, Ohio. Vice-presidents selected are Arthur Hewitt, Consumers Power Co., Toronto; N. C. McGowen, United Gas Public Service Co., Houston, Texas, and Howard Bruce, Bartlett-Hayward Co., Baltimore, Md. The newly elected officers of the technical section of the association are: I. K. Peck, Midland United Co., of Chicago, Ill., as chairman and J. A. Perry, United Gas Improvement Co., Philadelphia, Pa., as vice-chairman.

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Acetylene Association To Discuss Welding

WELDING technique in the chemical industry, particularly as it applies to recently developed equipment for high pressures and temperatures, will be a leading feature of the 32d Annual Convention of the International Acetylene Association, to be held at the Congress Hotel, Chicago, Nov. 11-13. The revision of the A.S.M.E. boiler code, following recent advances in the testing of welds, makes this discussion one of wide interest to chemical engineers. Other subjects to be discussed include welded piping and pipe lines, welding the new alloys, painting, enameling and lacquering welded joints, and engineering education in welding.

News from Washington

By Paul Wooton

Washington Correspondent of Chem. & Met.

ARMED WITH a report from a special committee of the Manufacturing Chemists' Association, the chemical industry will oppose every provision of the bill that Senator Bingham is planning to introduce in Congress next December to subject the sale of poisonous volatile substances to federal regulation under a criminal statute. The committee, of which Warren N. Watson, is chairman, analyzed every section of the measure drafted by Prof. Yandell Henderson, of Yale, and reports that the measure would prevent interstate shipment of all industrial chemicals of a volatile type, such as liquid chlorine and benzol, that have toxic qualities. This restriction resides in a provision of the bill that limits the issuance of permits by the Secretary of Agriculture to substances suitable for domestic or household use without endangering human life.

Only a minute fraction of the total consumption of chemicals ever reaches the household. Commenting on this feature of the bill, the committee's report states: "Thousands of products are regularly shipped in interstate commerce from the chemical industry to other industries which are not suitable for domestic or household use and which could have no possible application within the home. It is obvious that the Secretary of Agriculture could not give a permit on a multitude of key chemical products, as it would be impossible for him to hold the opinion that these essential products of industry are suitable for household use without endangering human life. In other words, this provision of the bill would automatically bar from interstate commerce a large part of the products of the chemical industry which are essential raw materials not only for that industry but for the group of industries known as the chemical process industries."

The committee's report suggests that if it is the intention of the Bingham bill to add further safeguards to the household consumer of chemical products, then the products elected might be added to the list specified in the Federal Caustic Poison Act.

THE definition given to a "poisonous volatile substance" is so broad as to make administration of the bill impracticable, in the opinion of the committee, and precludes any definite classification of chemical products. In embracing any material, the fumes or vapors of which may endanger human life, the definition fails to distinguish clearly between substances which do not have such effects and other commonly used substances which do not have such effects under any but the most extraordinary conditions. The committee's report points out that no effort is made to distinguish between varying degrees of toxicity nor to classify substances with respect to specific toxicity, concentrations, and duration of exposure. Ordinary carbonated water might, for example, endanger human life under certain conditions. Gasoline might do likewise, quite aside from its inflammable characteristics. Manufactured or natural gas may come within the scope of this bill, according to the committee, as it moves in interstate commerce through pipe lines.

The provision that any person injured as a result of violation of the act may recover damages opens up a large field for spurious claims, in the committee's opinion. The effect of this bill, according to the committee, would be to place the seller in a position in which by implication, he would warrant that every volatile product which he sells without the poison label can, under no circumstances, produce a toxic effect on human beings. Imposing such a burden on the chemical manufacturer or seller, it is declared, cannot be justified by law or ethics. Provisions with respect to the analysis of products and the issuance permits to such that, in the opinion of the Secretary of Agriculture, are suitable for domestic or household use without endangering human life raise questions, in the committee's mind, as to the justification for imposing such a cumbersome system upon the chemical industry.

PREPARATION of a manual on the care, filling, handling, and inspection of chemical containers such as tank cars, drums, and carboys has been placed in the hands of a new committee appointed at the September meeting of the executive committee of the Manufacturing Chemists' Association. The manual committee will coordinate the work of the association's technical committees by issuing a series of pamphlets in printed loose-leaf form which will serve the dual purpose of promoting safety and extending the life of chemical containers. The members of the committee are G. E. Tiley, chairman; T. P. Callahan, M. F. Crass, F. G. Moore, and W. N. Watson. The wide demand for the recent report of Mr. Callahan, chairman of the drum committee, on the handling and stowing of sulphuric and nitrating acid in drums demonstrated, said Mr. Watson, the need of the consumer as well as the manufacturer for a clear-cut operating code.

Because of the tremendous importance of the British chemical industry, Great Britain's abandonment of the gold standard will have a profound effect upon world chemical markets and the business of the American industry both at home and abroad. This will be manifest in the declining price of British products and in their increased ability to hurdle the tariff in the United States and in other countries.

It is expected, however, that the domestic chemical industry will indorse the administration's attitude that the break in sterling does not offer either excuse or justification for raising the Hawley-Smoot tariff. An increase in the tariff to compensate for the exchange discount would be only partially effective, as many chemical products are on the free list. Short of a tariff on creosote oil, therefore, the domestic industry would have little to gain, and the Tariff Commission, at the direction of Congress, now is running an investigation, assigned for hearing Oct. 30, to recommend to Congress a rate of duty that would equalize the disparity between British and domestic production costs. The procedure is the same as in investigations leading to adjustment of duties by presidential proclamation, but in this case Congress may act or not as it sees fit.

In so far as inflation in British prices for British products fails to compensate for depreciation in British currency there will, of course, be a decline in the dollar value of British goods. Trade experts anticipate that American manufacturers will feel the competitive effect of this condition more keenly in export markets than in the domestic market. British and American manufacturers are strong contenders for export business in alkalis and a multitude of lesser products.

A STUDY of the distressing conditions prevailing in the naval stores industry will be undertaken by the U. S. Timber Conservation Board, for the purpose, according to Ripley Bowman, the board's secretary, of developing a plan for its perpetuation. At a hearing tentatively assigned for Nov. 10, representatives of the industry will be invited to describe existing conditions and suggest measures to improve the economic status of the industry.

The study was undertaken on the board's own initiative. Mr. Bowman denied reports that the board previously had received and rejected a plea for help from the Gum Turpentine & Rosin Marketing Association, the cooperative organization whose attempts to stabilize the market for turpentine and rosin collapsed on its own head. The board's study will not conflict with a survey that the Domestic Commerce Division now is making of the marketing and distribution of naval stores.

Carl F. Speh, of Jacksonville, Fla., secretary of the Pine Institute of America, was enlisted by the board to participate in its analysis of the situation confronting the industry. Mr. Bowman pointed out that without the full cooperation of the disorganized industry the board's endeavor to lend a hand would be futile.

Faraday Centenary Observed by British Scientists

Inventor's Early Work and Developments Featured in Exhibits

From Our London Correspondent

THE POLITICAL and financial situation in this country has overshadowed all other activities and has made it almost impossible to comment authoritatively upon the trend of chemical industry. Whether the revaluation of the pound sterling will ultimately benefit chemical manufacture and export seems to depend largely upon corresponding measures, protective or financial, in European countries and by consumers of British products. The general view seems to be that there will be a period of readjustment, at the end of which the position of the British chemical industry will emerge in an improved condition.

The nigger in the woodpile, from the point of view of Imperial Chemical Industries, is obviously the nitrogen situation, and although quite recently sales of sulphate of ammonia in the home market have been satisfactory and leave a small margin of profit, export prices have slumped to such an extent, in spite of international quota and export adjustment, that the outlook is very obscure and probably depends upon whether the farmers of the world can afford to buy more fertilizers. Present indications point to an increased consumption, owing to the favorable price basis, and the fact that Chilean nitrate is being offered as high as £8 per ton in this country seems to indicate that the price war will not be of a cut-throat character. On the other hand, the depreciation in sterling will automatically restrict Chilean nitrate imports and may ultimately lead to a reopening of the negotiations which broke down so unnecessarily some months ago.

MANY developments which could apparently have been ruled out a month ago are again within the bounds of possibility, owing to altered circumstances, and among these we have the production of gasoline from coal by hydrogenation processes, to which reference has previously been made in these notes. There is first of all an increase of about 4c. per imperial gallon in the domestic price of gasoline, owing to the imposition of an additional revenue duty, and the price will now be further increased by 4c. because of the depreciation of the currency, and the spread may even become a little greater. Home-produced gasoline by Act of Parliament enjoys a preferential duty of about 8c. per gallon, so that if present conditions continue, the hydrogenation of coal in this country is definitely a commercial proposition and one which is likely to be encouraged, having regard to the fact that the quantity of oil and gasoline purchased annually by this country from abroad is valued at £42,000,000.

Particular interest will therefore be shown in the paper which is to be presented early next month by Dr. Ormandy before the Institute of Fuel and a number of associated societies, and dealing with the economic and technical aspects of this problem. Moreover, the unit plant which has been in operation for some time at Billingham on a scale of about 15 tons of coal per day, has now progressed sufficiently to permit of its being inspected by the representative British coal-mining interests and it would not be surprising to find that the idea of cooperation and production on a national scale will ultimately crystallize from this and from the general feeling that a beginning should now be made as an insurance premium for the future.

THE notable technical events of this month are the Faraday centenary and exhibition and the centenary meeting of the British Association for the Advancement of Science. The achievements of Faraday and the details of his incomparable researches, attainments, and character will have been broadcast throughout the world and were acknowledged in no uncertain manner by the scientists from every part of the globe gathered together in his honor. Similarly, technical journals of every description will be devoting considerable space to the flood of literature which has been made available on this occasion, so that in these notes it may suffice to say that the Faraday exhibition at the Royal Albert Hall, London, was not only brilliantly conceived and painstakingly arranged but gave more pleasure and afforded greater interest both to the lay and to the technical observer than any other exhibition which has been staged during the last twenty years.

As so often happens it was largely a question of "atmosphere" and in particular the first meeting at the Royal Institution, where the lecture hall in which Faraday communicated, over so many years and at such regular intervals, the results of his brilliant and classical experiments, has been preserved on the same intimate, modest, and impressive scale which has truly given it a claim to be the home of the experimenter and pioneer.

Particular reference should be made to the characteristic efforts made by the "grand old man of chemistry" in this country, Prof. H. E. Armstrong, who was responsible for staging the exhibits relating to the early work and ultimate development of Faraday's discovery of benzene. The diversity of all these discoveries is almost bewildering, but ultimately the fact emerges that it is only during the last twenty years that the progress of chemical engineering has enabled all the various industries which have been built up upon Faraday's discovery to attain their ultimate commercial and technical distinction. The London *Times* published a most interesting Faraday supplement to mark the occasion of the centenary, which is well worth reading in conjunction with the more detailed and technical literature which requires digesting at the present time.

THE Chemistry Section of the British Association arranged a symposium on the chemistry of vitamins, the discussion being introduced by Sir F. Gowland Hopkins, president of the Royal Society and one of the pioneers in this field. It would seem that much of the thought and recent work has been concentrated in this country, and in this connection the names of Profs. Drummond and Heilbron are prominent. Prof. Drummond is to contribute a paper on the recent progress made in the chemical study of vitamins before the London Section of the Society of Chemical Industry on Jan. 4.

The position of the rayon industry has undergone some improvement, partly on account of the gradual elimination of certain British factories, and partly because of better international understandings and reduced operating costs. The new varieties of matt rayon are finding increasing favor, but apparently two valid patented processes are available for use, and accordingly an interesting situation may develop later on. The Cellulose Acetate Silk Co., which apart from Courtaulds, Ltd., is the main competitor of British Celanese, Ltd., is well occupied, appears to have overcome the usual preliminary difficulties as regards production and markets, and is now paying its way. On the other hand, British Celanese, Ltd., has instituted suits for patent infringement against this company and also against Courtaulds, Ltd., and at present there seems little prospect of avoiding what appears to be a costly dispute.

New Building Dedicated For Paper Chemistry

THE new building that will house the Institute of Paper Chemistry, which is affiliated with Lawrence College, Appleton, Wis., was dedicated Sept. 23. Leaders of the pulp and paper industry came from every section of the country. James C. Kimberly was announced as donor of $100,000 to be used for construction of an addition to the new building as a memorial to his father, J. A. Kimberly, for half a century a pioneer in the industry in the United States. Gifts totaling $15,000 were made available for additional fellowships and scholarships for institute students during the next three years.

Rayon Industry in France Suffers From Overproduction

Competition and Reduced Demand Lower Profits of Producers

From Our Paris Correspondent

FROM a general point of view, the French industrial situation is still critical. Industry is undoubtedly going through a crisis resulting from a banking and monetary upset by which France is being affected just as other countries are, although not in the same proportion as Austria, Germany, and Great Britain.

The monetary situation in France may be imputed to the large amount of money in circulation. This reaches a total of nearly 80 billion francs secured by gold reserves of 60 billion francs. Money is so plentiful that the banks will not pay more ½ per cent to ¼ per cent interest on deposits. The large amount of money unemployed accounts for the decline in general buying and for the fact that many industrial shares are quoted at prices out of proportion to the intrinsic worth of the individual companies.

The opinion prevailing is that a Franco-German understanding would be the best means toward helping either country out of the critical situation. French people are unanimous in their opinion that the sums that might be advanced to the German government should in no case be used in furthering armaments or in sumptuary expenses and that these should under no circumstance be used in advances to the Russian government toward supporting the latter's quinquennial plan. Germany, however, does not seem to be willing to give the desired guaranty, which German people deem quite incompatible with their national dignity.

THE non-renewal of the Azote convention has so far but little affected French industry. It is a well-known fact that the latter had obtained the right to withhold the whole of the French production and their home market; it is also known that the home production does not entirely cover the country's requirements, especially as far as nitrogen is concerned. Such a decision, however, affects the Belgian Azote industry to a much more serious extent and has resulted in means of protection being already taken in the form of importing licenses.

We are aware that a sales syndicate was formed for a period of 10 years between the German, Dutch, Italian, and Swiss producers with selling offices in Berlin. France refrained from entering the syndicate and up to now the Comptoir des Textiles Artificiels has proclaimed it would interfere only when an agreement between all producers would be completed. It seems this condition has now practically been fulfilled if it is considered that France, Great Britain, and Belgium are now the only nations still remaining out of the consortium. Meanwhile, it is to be feared that, considering the diverging opinions and interests prevailing among European manufacturers, competition will become keener and will result in a further fall of prices.

The difficult position of the rayon industry was commented on in all general meetings recently held. A fact on which it has specially been insisted is that the creation of numerous factories in the course of the last few years has led to an overproduction of artificial silk, an overproduction that has further been aggravated by decreasing demand on the part of consumers and also by the closing up of several export markets such as the United States, for instance, where duties have become prohibitive. Anyhow, such a situation, apart from inducing a notable fall in prices, forced manufacturers to reduce or limit their production, in order to avoid overstocking, and even compelled some of the works to close up for a time.

WELL-established works of long standing, such as those of the Viscosa group, notwithstanding the declining prices, are still able to work with a certain margin of profit owing to reduction in their cost price. At any rate, the results of the year 1930 are far below those of the preceding year, as may be seen by the following figures.

The profits made by the Société Francaise de la Viscosa during the year 1930 amounted to 7,000,000 francs, against 11,000,000 francs in 1929; those realized by the Soie de Givet amounted to 5,300,000 francs, against 9,400,000 francs for the preceding period; the Société Ardéchoise de la Viscose made 985,000 francs, against 3,000,000 in 1929 and the same decrease has been noted with regard to all other similar undertakings. The dividends paid by the various companies decreased in the same proportion.

As far as more recently established undertakings are concerned the Textiles Chimiques du Nord et de l'Est, for instance, has suffered losses amounting to nearly 9,000,000 francs for 1930, while the Textiles Chimiques du Centre had to sustain a deficit amounting to 2,700,000 francs. Both the latter concerns belong to the Kuhlmann group, which was forced to reduce the production of a new factory recently established at Odornez toward the beginning of the present year.

The colonial exhibition held this year at Vincennes appears to have been a success. From a chemical point of view, however, there seems to be but little to mention apart from the essences and essential oil production from the French colonies, completing the already important home production used by the French perfumers. The yearly production of the South of France reaches from one to three million kg. of orange flowers, two million kg. of roseleaves, 750,000 kg. of jasmine flowers that are being distilled or enflowered toward producing the corresponding natural perfumes. The production of lavender oil also is very important, amounting to nearly 100,000 kg. yearly without speaking of other essences such as mint, tuberose, geranium, mimosa and rosemary essences, etc.

The discussion relative to the patent law has been taken up again by the Chamber of Deputies and several amendments were made which it is expected will be supported and accepted by the Senate. Among other modifications the term of validity of patents will be protracted from 15 to 20 years, while one of the entirely new provisions of the amended law consists in a single tax of 1,000 francs to be paid at the time of registration.

The principle of patents covering special manufacturing processes was admitted, as far as chemicals are concerned, under the understanding that any particular chemical obtained through a patented process shall be considered, in the absence of contrary evidence, as having been obtained through such process only.

The law of 1844 admitted patents applying to chemical bodies, which means that even chemical compounds were covered by the patents and could not be prepared, even through entirely different processes, as long as the initial patent remained in force. The French patent law thus tends to meet the provisions of the laws of other countries.

Free Course in Chemistry At Cooper Union

FREE night courses in chemistry to enable graduates of a decade ago to keep abreast of the advances in science are announced at Cooper Union, New York City. James Coull, instructor in physical chemistry, will give a course in "Chemical Thermodynamics" every Tuesday evening through Jan. 12.

Prof. Albert B. Newman, head of the department of chemical engineering, will lecture on "Unit Operations of Chemical Engineering" every Monday evening from Oct. 19 to Jan. 18. The lecture period in each course is from 7:30 to 9:30 p.m. More than 150 students holding degrees from colleges and universities in this and other countries are expected to enroll. Applications have been received from doctors of philosophy in chemistry, managers of chemical industries, consulting engineers, and scientists engaged in industrial research. The courses are planned to develop a center of adult education in science and engineering at the Union.

Output of Coal-Tar Products Drops Sharply in Germany

Surplus Stocks and Restricted Outlets Close Some Coke Plants

From Our Berlin Correspondent

THE RAPID constriction of business is having its effect throughout the entire chemical industry. A clear picture and example of the situation is to be seen in the coal industry. Not only has activity in coal declined greatly throughout the world but Germany has had a disproportionate share in this decline. Consumption of hard coal has decreased by one-fifth since 1928 and consumption of lignite by one-fourth, and when it is considered that in all the surrounding nations precautionary measures have been taken to protect home industry, the possibility of an international agreement is quite remote. Furthermore, the Ruhr Syndicate has based current business on the English pound and consequently shares in its decline.

Of course, byproducts of coal have declined in sympathy. Average monthly coke sales in German Silesia have declined from 81,391 tons in 1930 to 76,800 tons early this year, both from 141,800 tons in 1929. Nevertheless, stocks are still high. In fact, all products—tar, oils, ammonium sulphate—except benzol have been severely hit. Of course, a number of plants are idle and it may incidentally be mentioned that since 1927 over 300 iron foundries have closed their doors. Employment in them has shrunk to less than one-half of normal.

Larger companies also are feeling the force of the situation. Even the Metallgesellschaft A. G., Frankfurt, which had already reduced its dividends from 8 to 5 per cent in the previous year, probably will omit it entirely this year. While a surplus may be expected from the business year, nevertheless the influence of the general situation on the necessity for writing off will not justify a dividend. Some plants are trying to avoid disaster by merging. Thus the greatest chemical plant next to the I. G. Farbenindustrie, the Schering-Kahlbaum A.G., which already belongs to the Kokswerke und Chemischen Fabriken A. G., intends to merge with the Lingner Werken, Dresden, producer of well-known drugs and pharmaceuticals.

THE I. G. was successful in an important progressive in the field of hydrogenation recently. Through the development of an extraordinarily effective catalyst, the capacity of the coal-tar hydrogenation at Leuna can be raised from 100,000 tons of gasoline annually to 350,000 tons, without necessitating any additional investment. In any case, this signifies that the Leuna gasoline could account for one-fifth to one-fourth of the domestic demand in motor fuels. The constitution of these new catalysts has not yet been made public, but it seems probable that they will be of significance for oil as well as coal hydrogenation.

By the order of the government making the admixture of alcohol with motor fuels compulsory it will be possible for the alcohol price to undergo a reduction and therefore for the admixture quota of alcohol to be raised from 3½ to 6 per cent. This high quota will make possible an alcohol consumption in this field of about 1,000,000 hectoliters, without creating an additional burden for the consumer. Coke-oven gas contains small quantities of nitrogen oxide, which often causes operating difficulties later in the separation of the gases through pressure and cooling. According to a new process by Tropsch and Kassler, a catalyst of molybdenum and tungsten sulphide converts the oxides into harmless ammonia. The process can be operated with a rapid turnover, especially under pressure.

A very interesting anti-freeze compound produced by the I. G., although its composition is not indicated, is now marketed under the name "Glysantin." Mixed with water to the extent of 34 per cent, it keeps its liquid down to minus 20 deg. C. Beneath this temperature, a crystalline flocculent precipitate forms within a still liquid medium, which expands only by one-half per cent. At still lower temperatures, the solution is converted into a fluid paste of about the consistency of ice cream. But even at the lowest occurring temperatures, no solid fractious ice forms. The material was very successfully used in the northern flight of the "Graf Zeppelin" recently, where considerable quantities of water had to be kept liquid.

A new iron for casting, called Migra (from Mikro-Graphit) is now being offered by the Vereinigte Stahlwerke. On fracture it shows a very fine grain and very favorable lodging of graphite.

Paper Problems Discussed At T.A.P.P.I. Meeting

MORE than 200 members of the Technical Association of the Pulp and Paper Industry met at Kalamazoo, Mich., on Sept. 24-26, to discuss some of the important technical problems confronting the industry. One of the important industries in the Kalamazoo Valley is devoted to the manufacture of book and printing papers from sulphite and de-inked magazine stock. In the symposium on de-inking Charles A. Shubert, of Dill & Collins Co., Philadelphia, Pa., described the paper recovery process used in his mills.

C. C. Irving, of the Falulah Paper Co., Fitchburg, Mass., outlined the problem of disposing of wastes from deinking plants. Such wastes consist of alkaline water holding in suspension or solution soaps, ink residues, short paper fibers, and clay. A settling basin was recommended as the best medium for separating the solids from the water, possibly using a vacuum filter to aid the separation.

The steam requirements of the deinking process were discussed by E. G. Milham, of the Watervliet Paper Co., Watervliet, Mich.

This meeting was the first in which a number of papers were contributed by the Institute of Paper Chemistry, the new graduate school at Appleton, Wis. These papers covered such subjects as the bleaching of kraft pulp, yield, and quality of pulp as occasioned by recooking the same in digesters which were not blown clean. Dr. Otto Kress, technical director of the institute, presented the papers, although several members of the institute staff assisted in their preparation.

P. K. Baird, of the Forest Products Laboratory, contributed a paper outlining the proposed research program of the Technical Association relative to the study of the use requirements of paper. R. H. Doughty, the T.A.P.P.I. fellow at the laboratory, showed the relationship between tensile strength and basis weight and related factors in paper, and G. H. Chidester, in reading a paper on the re-use of relief and waste liquors in sulphite cooking acid, showed the limits to which this may be done.

T. R. Le Compte, John A. Manning Paper Co., fellow at the Mellon Institute, read a paper on hydration measurements by the boiling method. B. S. Summers, of the Michigan Steel Casting Co., Detroit, Mich., discussed the use of chromium nickel castings in the sulphite industry. M. N. Davis, of the Kimberly-Clark Corp., Neenah, Wis., indicated the present status of the industry's methods for measuring paper opacity. J. J. Healy, Jr., of the Merrimac Chemical Co., Boston, Mass., reviewed the details of alum manufacture and its use in the paper industry. In considering the future, it was stated that nothing is likely to replace alum in its present uses.

W. G. Schlichting, of the Clarage Fan Co., Kalamazoo, Mich., described the application of humidity control in the paper mill and printing plant and also indicated the details concerning constant - humidity testing - room construction. J. K. Speicher, of the Hercules Powder Co., read a paper illustrated by motion pictures showing how nitrocellulose is made.

There was, in addition, an excellent program of mill visits, committee meetings, and recreation. At one of the banquets the Kalamazoo Valley Section of T.A.P.P.I. was officially installed by President M. A. Krimmel.

MEN

IN CHEMICAL ENGINEERING

FRANK J. TONE, president of the Carborundum Co., Niagara Falls, N. Y., received the award of the Jacob F. Schoellkopf medal in Buffalo on Sept. 2 at a meeting of the Western New York section of the American Chemical Society. The medal, awarded to encourage the spirit of research in industry, was awarded to Dr. Tone for his outstanding contributions on industrial electrochemistry, notably silicon. Although Dr. Tone's early career and education centered around electrical engineering, he became associated in 1895 with Edward G. Acheson in the development of silicon carbide and artificial graphite at Niagara Falls. Since 1899 he has directed his company's activities. Among his achievements were the first process for production of silicon metals, the discovery of silicon monoxide and fibrous silicon oxy-carbide and silicon carbide heating elements. Mr. Tone, who also is president of the Globar Corp., is past president of the Electrochemical Society.

E. J. LORAND, H. M. SPURLIN, and KYLE WARD, JR., of the Hercules Powder Co., have returned to the company's headquarters at Wilmington, Del., after studying for the past two years in Berlin on cellulose problems.

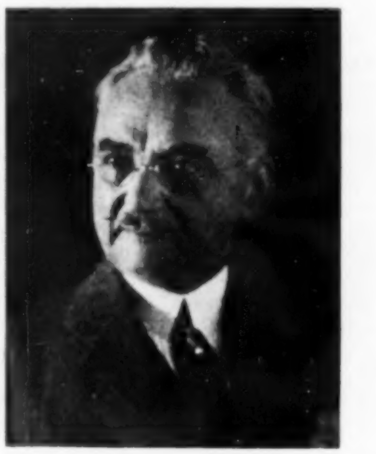
PERRY D. HELSER has resigned his position as vice-president of the Eljer Co., Ford City, Pa., to become executive vice-president and general manager of the General Ceramics Co., New York City.

LOUIS LINK has retired as general superintendent of the Baton Rouge refinery and director of the Standard Oil Co. of Louisiana after 43 years of uninterrupted service. After coming to this country from Bavaria in 1882, he took various industrial jobs, finally ending in the Bayway refinery of the Standard Oil Co. (N. J.). Three years later he went to Baton Rouge temporarily, but stayed on and in 1915 became refinery superintendent. In his career in refining, his work is identified with many of the improvements of the past four decades.

W. S. BRIMIJOIN, formerly superintendent of the Hercules Powder Co.'s explosives plant in Emporium, Pa., has joined the safety and service department of the home office in Wilmington, Del., where he will study the elimination of explosive hazards throughout the company's plants. His connection with the Hercules Powder Co. began in 1914, but he has been in the explosives industry since 1906.

M. J. RATHBONE, JR., who has been stationed at the Baton Rouge refinery of the Standard Oil Co. of Louisiana since his graduation as chemical engineer from Lehigh in 1921, has succeeded Louis Link as superintendent of the Baton Rouge refinery.

HORACE BOWKER, president of the American Agricultural Chemical Co., New York City, has been appointed a divisional chairman of the commerce and industry division of the Emergency Unemployment Relief Committee. Mr. Bowker will be at the head of the division's activities in the chemical trades.



MAXIMILIAN TOCH

HENRY M. TOCH has resigned as chairman of the board of Standard Varnish Works and as president of Toch Bros., Inc., after 50 years devoted to active business, but will continue as a director and chairman of the board of Standard Varnish Works.

MAXIMILIAN TOCH will succeed his brother as president of Toch Bros., Inc., and continue as vice-president of Standard Varnish Works. In a sense his new position is only a culmination of achievements in the paint industry that began with his graduation from New York University in 1884. Aside from his contributions to the technology of paints, his interest has been broad enough to make him an authority on various different phases of the subject. Thus he is professor of the chemistry of painting at the National Academy of Design, has published several books on permanence in artistic and industrial painting, and several years ago came into public prominence by applying scientific tests to the authenticity of numerous old paintings.

MELVIN C. MOLSTAD has resigned from the ammonia division of E. I. duPont de Nemours & Co., at Charleston, W. Va., to become assistant professor of chemical engineering at Yale University.

KARL T. STEIK, formerly of the Standard Oil Development Co., has been appointed director of research at the new laboratories of the National Oil Products Co., Harrison, N. J. A native of Germany, Dr. Steik studied there and obtained several degrees in this country before teaching at Wyoming and Florida. His industrial career began with the Sun Oil Co.

MARION D. COULTER has been appointed a fellow of the Mellon Institute of Industrial Research for work on a new fellowship involving research in paper board.

W. F. GOLDSMITH, former chief consultant on pulp production and fiber board manufacture for Arthur D. Little & Co., Boston, Mass., has been made technical director of the Hawaiian Cane Products, Ltd., Honolulu, with headquarters at San Francisco.

DONALD F. GERSTENBERGER has resigned as refinery manager for the American Refining Properties, Wichita Falls, Texas, to join the staff of the Universal Oil Products Co., Chicago. After beginning his career as still fireman for the Standard Oil Co. (New Jersey) in 1913, he was promoted to assistant general superintendent at the Charleston plant of the same company in 1919. In 1923 he became general refinery superintendent of the Louisiana Oil Refining Corp.

STERLING TEMPLE, B. F. LACEY, A. M. MUCKENFUSS, J. F. REICHERT, C. J. WERNLUND, A. T. HAWKINSON, A. W. RUDEL, J. M. WAINSCOTT, H. A. BOND, and I. L. RESSLER, all of the research staff of the Roessler & Hasslacher Chemical Co., Inc., have been transferred from the plant at Perth Amboy, N. J., to the one at Niagara Falls, N. Y.

L. V. REDMAN, vice-president and director of research of the Bakelite Corp., has been selected to receive the Grasselli medal for 1931, the presentation to take place on Nov. 6, at the Chemists Club, New York City. The award, made by the American Section of the Society of Chemical Industry, was based on Dr. Redman's paper, "Cost of Research and Its Apportionment," which he read before the society in December, 1927.

ROBERT J. PIERSOL, who has been a consulting engineer specializing on chromium plating, is now physicist with the State Geological Survey of the State of Illinois, and is located at Urbana.

LINN H. ENSLOW has resigned as research engineer of the Chlorine Institute, Inc., to become a consultant and the editor-in-chief of *Water Works & Sewerage*. During the past few years he had already been an associate editor on this journal, after an extensive career devoted to waste disposal problems.

Patriarchs of Industry

As a corollary to the fitting ceremonies both here and abroad, commemorating Faraday, it is interesting to find that two contemporary personalities in the chemical industry are also being duly celebrated this year.

Carl Duisberg, president of the Federation of German Industries and chairman of the board of directors of the I.G. Farbenindustrie, celebrated his 70th birthday on Sept. 28. It was a memorandum in 1904 by Dr. Duisberg, resulting in a "community of interest" agreement in the German chemical industry, which eventuated in the dye trust and later in the formation of the I.G. Farbenindustrie. Ten years ago Dr. Duisberg published his reminiscences but has since then devoted even more energy to the ensuing highly critical decade of the German chemical industry.

L. Edeleanu, the greatest chemist of Roumanian birth and outstanding figure in petroleum technology, completed his 70th year on Sept. 14. Dr. Edeleanu studied in Roumania and Germany and later taught in England and Roumania. In his native land he became a co-founder of the Society for Physical Science and in 1900 organized the laboratory of the Roumanian Ministry of Agriculture and Domains. Since his occupation with petroleum refining in 1900, his position has grown to international eminence. He has been adviser to banks on the oil industry, was principal director in the exploitation of Roumanian resources, and has constantly been active in the development of new refining and manufacturing processes.

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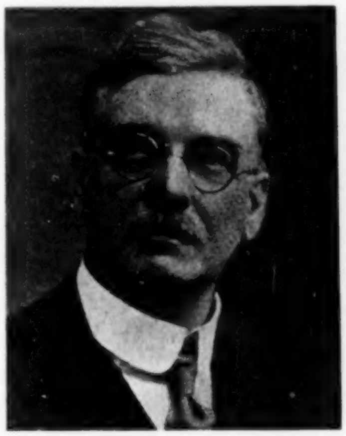
OBITUARY

Francis M. ("Borax") Smith, one of the foremost California mining pioneers, died at his home in Oakland, Calif., on Aug. 26. Mr. Smith was born in Richmond, Wis., in 1846, and went to California in 1867. He became borax king of the world through his "Twenty-Mule Team Borax." At the time he made his first borax discovery in 1872, borax was selling at $5 per pound. By his efforts at production, the price was brought to 10 cents and borax marketed as a common household commodity. He was essentially a man of action and with him action spoke of accomplishment. His interests were many, including those of a philanthropist, patron of arts and letters, sports, yachting, and civic endeavor. The Western chemical industry, so closely related as it has been to the mining industry, markedly felt the influence of this pioneer.

Robert D. Platt, chief engineer of the Koppers Construction Co., died suddenly at his home in Pittsburgh, Pa., on Sept. 25 at the age of 46. He had been with the company uninterruptedly since 1912, when he joined after serving in various engineering capacities in steel works.

J. W. Hinchley, who died in August in London, was first occupant of the chair of chemical engineering at the Imperial College of Science and Technology, London. He was born in 1871 at Grantham and after completing his education soon went to London to teach. Between 1896 and 1903 he intermittently taught and was employed industrially. From 1903 to 1910 he was employed at the Siamese Mint at Bangkok, but after his return devoted himself seriously to the teaching of chemical engineering. He was later active in the formation of both the chemical engineering group of the Society of Chemical Industry and, in 1922, of the Institution of Chemical Engineers, of which he became secretary until his death.



J. W. HINCHLEY

"Chemical engineering has suffered a great loss by the untimely death, after a long illness, of J. W. Hinchley. One cannot do better than quote Prof. Armstrong in saying that as a teacher, Prof. Hinchley was unrivaled: he treated his subject with a common sense, a breadth of outlook, and in a practical way, which made his pupils of altogether special value in industry. Used by him, the term 'chemical engineer' had real significance, with none of the pretense to attain the impossible that is too often associated with it. His students were made aware of their limitations; above all, he aimed at training them to be thoughtful and use their knowledge. His chief characteristic, however, was his simple, entirely sympathetic nature. He did immense social service as an organizer. A man of affairs, no mere technical dry-as-dust, he was ever helpful; indeed, too unsparing of himself in his efforts to aid others. The writer himself owes much of his early training to Prof. Hinchley, who at the time was an assistant in his father's office, and the best monument to his career and work will be the full development of chemical engineering training and the profession of a chemical engineer."—*C. J. Goodwin.*

Edward F. L. Lotte, vice-president and general manager of the National Silk Dyeing Co., died of heart attack at his home in Paterson, N. J., on Sept. 24, at the age of 63. Mr. Lotte had studied chemistry at Temple University, Philadelphia, and when his education was completed, obtained some industrial experience. In 1903 he formed the firm of Lotte Bros. Co., of Allentown, Pa., and was its president until it merged in 1909 with several other companies. In chemical circles his name was among those foremost in the technical application of dyes to textiles.

Joseph Merritt Matthews, authority on textile chemistry and dyestuffs, died in San Diego, Calif., on Oct. 12 at the age of 57. Born and educated in Philadelphia, Dr. Matthews was head of the department of chemistry and dyeing in the Philadelphia Textile School from 1898 to 1907. Thereafter his activities gradually centered around New York City, where he became a consultant and, after 1917, editor of *Color Trade Journal.* During the War he expended much effort in making the American dye industry competitively successful. In New York he was long a familiar figure at the Chemists Club.

George T. Walker, president of George T. Walker & Co., Inc., Minneapolis, Minn., died at the age of 47, on June 19, 1931, after an illness of only a week. He established this firm about eight years ago and was also inventor of the Swenson-Walker continuous crystallizer.

William Hammett Hunter, head of the department of organic chemistry at the University of Minnesota, died on Aug. 19 after an illness of several months. Dr. Hunter was born in Boston in 1882, attended Harvard University, and became instructor in chemistry for one year at Bucknell University. His association with the University of Minnesota began in 1909 as instructor in chemistry. He was made professor and head of the department of organic chemistry in 1920, a position he occupied until his death.

Henry William Huning, vice-president of the Mallinckrodt Chemical Co., St. Louis, Mo., died on Sept. 13, 80 years of age. Mr. Huning had the distinction of being the fifth employee of the late Edward Mallinckrodt, who in 1867 began manufacture of chemicals.

CALENDAR

American Institute of Chemical Engineers, fall meeting, Atlantic City, N. J., Dec. 9-11.

American Petroleum Institute, 12th annual meeting, Chicago, Nov. 10-12.

American Society of Mechanical Engineers, annual meeting, New York, Nov. 30-Dec. 4.

Electrochemical Society, spring meeting, Baltimore, April 21-23.

Materials Handling Exposition, first meeting, New York City, indefinitely postponed.

Third International Conference on Bituminous Coal, Pittsburgh, Nov. 16-21.

ECONOMIC INFLUENCES

on production and consumption of CHEMICALS

Chemical Output Records Gain In Last Month

Seasonal Influences Encourage Higher Rate of Productive Activities

BASED ON reports of electrical power consumption, the rate of production activities in the chemical industry was speeded up throughout the month of September. The index of activity was placed at 131.3, as compared with 129.1 for the preceding month. With the passing of the hot-weather period it is customary to find an increase in manufacturing operations, with a consequent gain in the outlet for raw materials. That such a condition existed last month is shown by reports of increased power consumption over August, as follows: leather, 4.8 per cent; textiles, 3.7 per cent; stone and glass, 8 per cent; pulp and paper, 16.6 per cent; rubber, on the other hand shows a drop of 10.5 per cent for the month, which is largely represented by a decline in output of tires.

A comparison of production and consumption figures for such branches of the chemical and chemical-consuming industries as are available for the first eight months of the year shows the following:

Production	Jan.-Aug., 1931	Jan.-Aug., 1930	Per Cent of Change
Acetate of lime, 1,000 lb.	35,179	51,541	—31.7
Arsenic, crude, ton	14,184	12,519	+13.3
Arsenic, ref., ton	9,752	7,576	+28.7
Byproduct coke, 1,000 tons	23,245	32,467	—28.4
Explosives, 1,000 lb.*	183,877	225,921	—18.6
Methanol, crude, gal.	2,507,716	3,179,626	—21.1
Methanol, ref., gal	1,388,716	3,104,813	—55.2
Methanol, synthetic, gal	5,142,010	4,072,850	+26.2
Petroleum refined, 1,000 bbl	598,765	635,590	— 5.8
Sulphuric acid, by fertilizer industry, ton*	843,227	1,264,273	—33.3
Turpentine, wood, bbl	41,123	57,769	—28.8
Rosin, wood, bbl	239,858	334,725	—28.3
Consumption			
Cotton, bales	3,684,523	3,719,990	— 0.92
Wool, 1,000 lb. grease equiv	363,389	289,802	+25.4
Silk, bales	385,325	351,883	+ 9.5
Plastic, cold-water paints and calcimines, sales, 1,000 lb.	41,308	45,502	— 9.2

*Figures are for seven-month periods.

Sales of paints, varnishes, and lacquers for the eight-month period were valued at $205,818,980 in 1931 and at $348,400,057 in 1930. Because of lower prices the loss in quantity this year was not so extensive as that for values, but there can be no doubt that the paint industry as a whole has fallen far below its 1930 level. Sales of pigments and raw materials in August were reported at 14,751,557 lb., or a gain of 7.28 per cent over July, which may be taken as an indication that production of paints has increased since July.

THE fertilizer industry, which has been unduly backward this year, did not start off the new season with any higher rate of operations. According to the National Fertilizer Association tag sales in the sixteen tag sales states for Aug.-Sept. were only 67.4 per cent of the totals for the corresponding two months of 1930.

Automobile production has a direct effect on consumption of a varied line of chemicals, and the automotive output for the first eight months of this year reached a total of 1,978,622 units, compared with 2,688,481 for the like period of 1930. This is a loss of more than 26 per cent, and it is logical to presume that consumption of chemicals in that industry suffered a proportionate decline.

Analysis of foreign trade gives evidence that a slower in and out movement has contributed to the general falling off in the chemical industry. For the January-August period of this year exports of chemicals and related products were valued at $71,184,459, compared with $91,730,095 for the eight-month period of 1930. Coal-tar chemicals contributed largely to this decline, with only dyes and colors making a fair showing. The industrial chemical group shows comparisons of $16,260,909 and $13,979,498 for 1930 and 1931, respectively. Sodium compounds were reported at 364,925,193 lb. for 1930 and 346,676,197 lb. for this year, sulphate and caustic being the only ones to improve over last year's totals. Lithopone and lampblack registered gains in the pigment classification, although the division as a whole lost ground. Fertilizers and fertilizer materials moved out in smaller volume, although sulphate of ammonia held up well.

Import trade shows a valuation of $59,082,838 this year, against $82,043,044 for 1930. The decline was general throughout the various divisions. Coal-tar acids and dyes offered an exception in the coal-tar group. A marked decline was noted in the case of importations of acetic acid, but oxalic acid arrived in larger volume. Potash salts suffered a severe decline as a result of our drop in fertilizer production, but this was true of other fertilizer materials.

Imports of salt cake were not included in the monthly summary for 1930 but Jan.-Aug. imports this year were recorded at 112,236,794 lb. valued at $622,107.

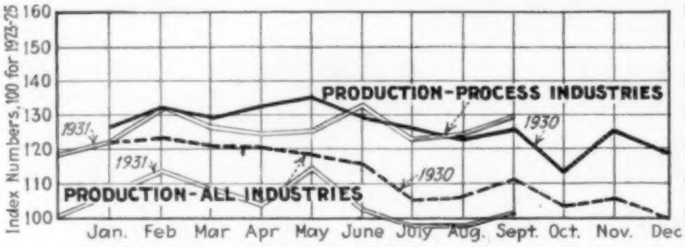
Sales and Distribution Of Lime in 1930

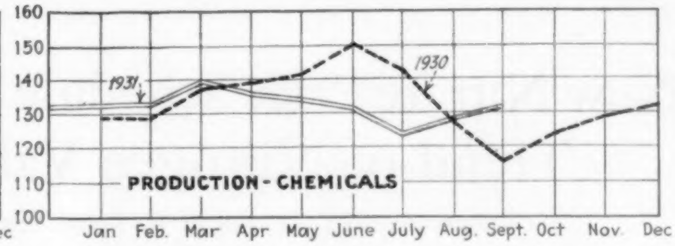
LIME sold by producers in the United States in 1930 amounted to 3,387,880 short tons, valued at $25,616,486, according to figures obtained from a compilation of reports made by lime manufacturers to the U. S. Bureau of Mines. This represents a decrease of 21 per cent in quantity and 23 per cent in value as compared with 1929.

Sales of lime used in the manufacture of chemicals—1,840,155 tons, valued at $13,193,437—decreased 20 per cent in quantity and 21 per cent in value; lime sold for construction—1,204,614 tons, valued at $10,050,270—decreased 27 per cent in quantity and 30 per cent in value; and that sold for agricultural purposes—343,111 tons, valued at $2,372,779—increased 1 per cent in quantity but decreased slightly in value. The following table shows sales of lime by uses in 1929 and 1930:

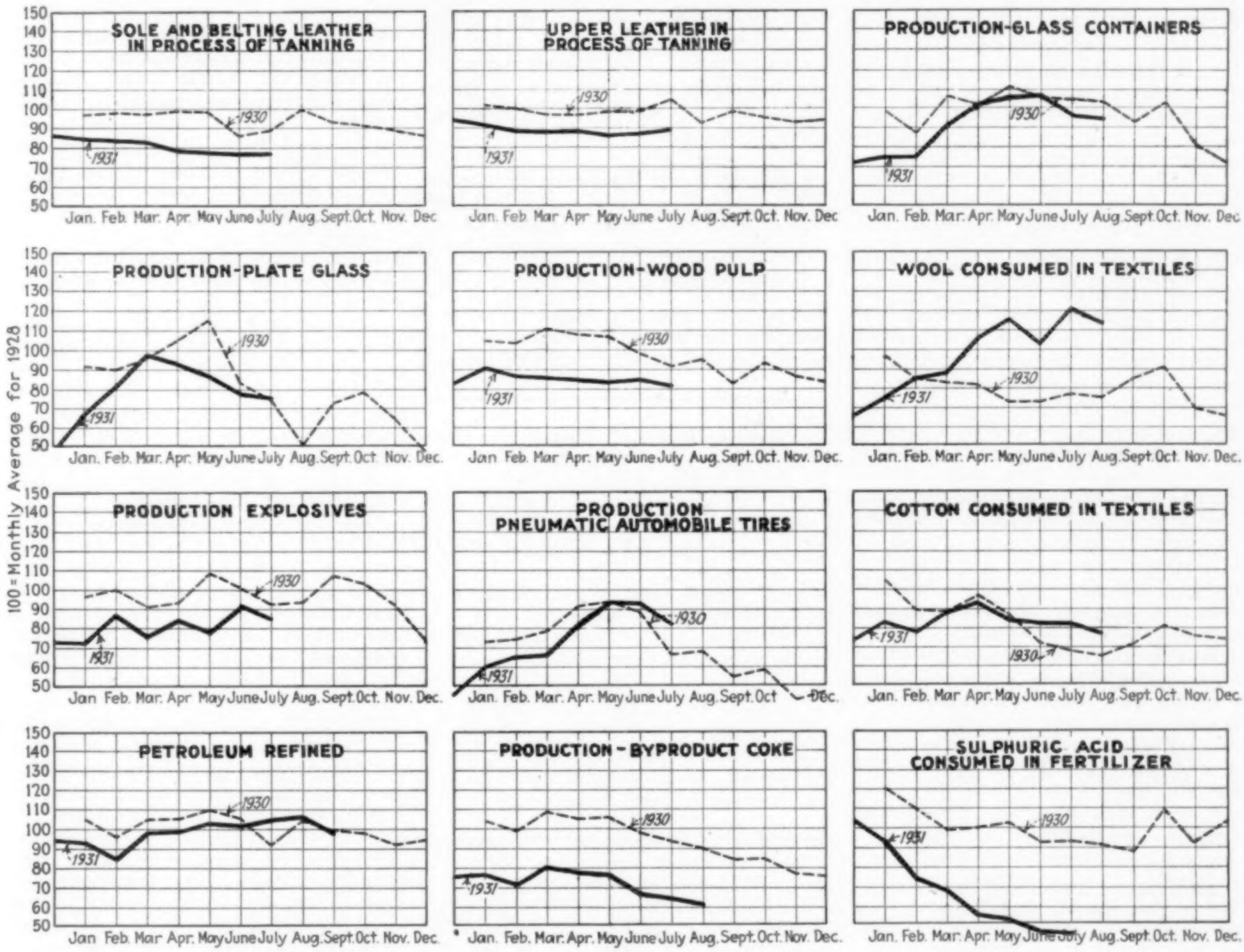
Use	1929 Short Tons	1930 Short Tons
Agricultural	338,329	343,111
Building	1,640,827	1,204,614
Chemical:		
Glass Works	75,283	62,912
Metallurgy	578,488	415,692
Paper mills	411,017	378,721
Refractory lime (dead burned dolomite)	488,032	351,727
Sugar refineries	20,758	18,905
Tanneries	67,046	56,526
Other uses	649,988	555,672
Total chemical	2,290,612	1,840,155
	4,269,768	3,387,880
Hydrated lime (included in above totals)	1,550,771	1,329,562

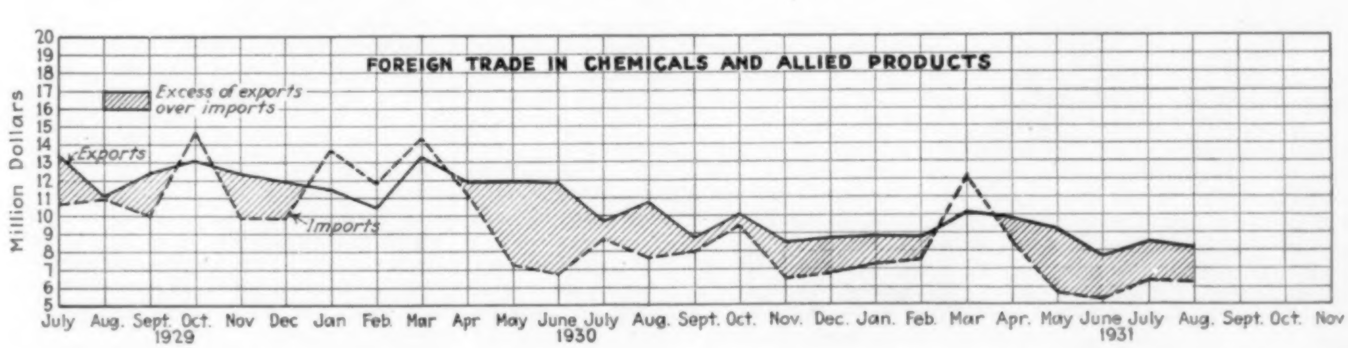
ACTIVITY IN PRODUCING AND CONSUMING INDUSTRIES





Based on electrical power consumption, data supplied by Electrical World





MARKET CONDITIONS —AND PRICE TRENDS

New Nitrate Price Schedule Follows Trend of Nitrogen Values

Chilean Product Offered at Reduced Figures for October-June Deliveries

PENDING the outcome of negotiations for an international production and sales accord, European producers of nitrogenous fertilizer sales did not publish their price schedules for the fertilizer year 1931-32 until the possibility of an agreement between themselves and the Chilean industry seemed remote, according to the Bureau of Foreign and Domestic Commerce. In former years it was customary to announce prices about July 1, the beginning of the fertilizer year.

Producers of Chilean nitrate of soda likewise refrained from naming new contract prices for their product until Oct. 1, when the new schedule for United States deliveries was made public. The new price list follows the trend of other nitrogenous products and is established at a level below that which was in effect a year ago. For nitrate packed in bags the new price is $1.77 per 100 lb. ex-vessel at American ports. The price covers all positions from Oct. 1 through June, 1932.

The world situation in regard to nitrogen still remains in an unsettled state and, as many European countries have producing capacities far in excess of home requirements, the probability of keen competition in export trade is evident. This has taken material form in domestic markets for some time because of low-priced offerings of sulphate of ammonia from abroad. These offerings still continue to be made and prices for domestic sulphate are largely nominal as a result.

ONE of the important developments of the month was found in the action of chemical prices in the English market. The *Chemical Trade Journal* on Oct. 2 reported that not for over a decade have the chemical markets been the scene of such general activity as during the past week. With the devaluation of the pound sterling, prices of almost all imported chemicals and allied products mounted by figures varying from 10 to 30 per cent, while the uncertainty as to the future course of values is so pronounced that suppliers are in most cases unwilling to conclude contracts, or even to quote at all, for future deliveries at specified prices. This has inevitably had an unsettling effect on trade, although a good number of orders were placed during the week by buyers who consider that top values have not yet been reached. It may be another week or two before values, as quoted in sterling, really settle down; in the meantime quotations can be taken as having only a nominal or approximate value.

AMONG tariff developments was an announcement from the U. S. Tariff Commission that a public hearing would be held in Washington on Oct. 30 on the question of production costs of dead or creosote oil in this country and in the principal competing country. This action is in accordance with an investigation order last March. In 1930, domestic production of creosote oil was 122,571,822 gal., as compared with 127,749,844 gal. in 1929. Imports in 1930 were 66,921,827 gal. Imports for the first eight months of this year amounted to 28,080,225 gal., showing that the domestic product was supplying a large part of domestic requirements. Installations for the recovery of creosote oil from tar that formerly would have been consumed as fuel made considerable progress in 1928, and with normal activities at coke plants this country could supply its requirements of creosote oil.

Interest in coal-tar chemicals was heightened early this month as a result of marking up quotations for such important selections as benzol, toluol, solvent naphtha, and xylol. Production of these chemicals had been restricted for some time and, as surplus stocks had been taken from the market, the law of supply and demand worked in favor of an advance in sales prices.

Soviet Export Trade In Alkalis

Soviet exports of soda ash, caustic soda, and sodium bicarbonate during 1930 were 31,487 metric tons, compared with 7,498 for the preceding year. During 1930 the principal countries of destination of these commodities were: 7,198 metric tons to Germany, 3,697 tons to Argentina, 3,554 to Belgium, 2,707 to Greece, and 2,391 to Japan, while smaller amounts went to 18 other countries.

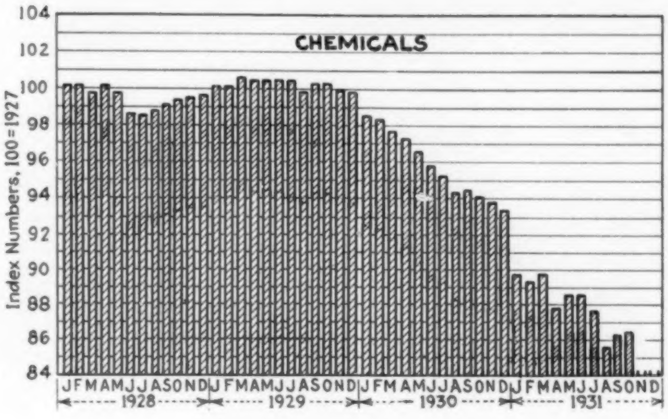
CROP news of market importance consisted in the issuance of a higher estimate for the yield of cotton. The larger supply of cottonseed thus forecast was a bearish factor on values for cottonseed oil and it is apparent that low average prices will be recorded for the 1931-1932 season. The probable yield of flaxseed was placed at 11,500,000 bu. Ordinarily this would have strengthened prices for linseed oil, but demand for the latter has fallen off to such an extent this year that the price for oil declined during the month. Incidentally the second official estimate on flaxseed acreage in the Argentine places the total at 8,341,000, which compares with 7,400,000 acres for 1930.

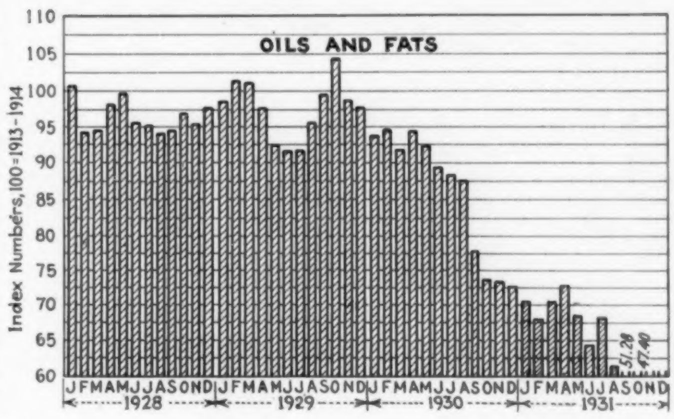
Tartaric acid of foreign origin has been a strong competitor of the domestic product and selling pressure has forced prices to very low levels. It is reported that stocks in foreign markets are not unduly large. One large plant in Italy is said to have been closed for some time and some factors in the trade hold that competition from abroad is not due so much to a desire to reduce present holdings as to a plan to enlarge export trade from Italy and thus permit of a larger production in that country. It is also probable that lessened demand in other markets has influenced Italian producers to concentrate on the American market.

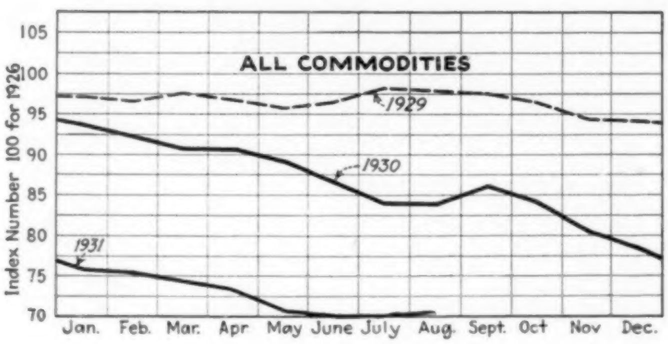
THE U. S. Timber Conservation Board, recently organized under the chairmanship of the Secretary of Commerce to survey underlying economic factors affecting the nation's forest industries and to recommend a cooperative program between industry and government for the amelioration of conditions, will undertake a study of the naval stores industry in the course of its work. The cooperation of the naval stores industry has been solicited and the plan already has been discussed by all the parties interested. The investigation will include a complete study of the economic phases bearing upon its present welfare and future prosperity.

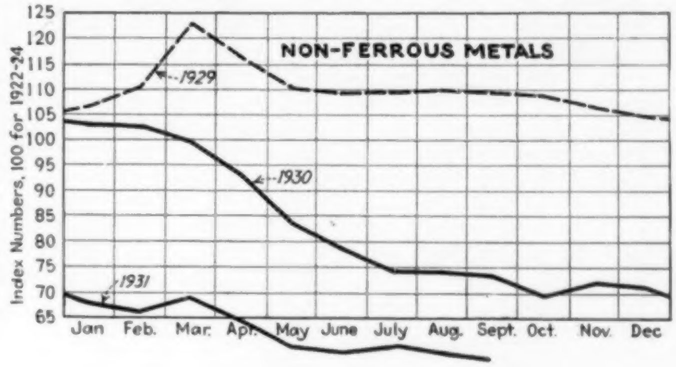
There was but little change in the naval stores market during the last month. Buying for domestic account has been along routine lines, with no material improvement in sight. Export business is falling considerably below that of last year and foreign markets do not appear to be working into a more favorable position.

CHEM. & MET. *Weighted Indexes of* PRICES









Producers Slow to Establish New Contract Prices

As an indication of what may be expected as an average price level for next year, considerable interest has been shown in the question of contract prices covering deliveries over next year. Producers of the more important chemicals have quoted figures in a few cases, but there has been no attempt so far to establish general contract prices for alkalis, mineral acids, and other heavy chemicals in which price interest is the keenest. Producers are content to await developments which may enable them to form a more definite opinion regarding future activity in consuming industries. The absence of price-cutting tactics which marked trading in the latter part of 1930 and in the early part of this year speaks well for the stability of prices and is an indication that business for 1932 will be written with a view toward conserving a definite relationship between cost and sales prices.

A short time ago rumors were current to the effect that new contract prices for soda ash and caustic soda would be higher than the figures now quoted. The failure of consumers to take delivery of contract holdings up to the stipulated amounts brought out reports that producers were carrying surplus stocks and this in turn gave rise to the hope that under the influence of such surpluses selling pressure might develop which would present an opportunity for placing new contracts at a low price. From prices actually quoted to direct inquirers there is no reason to believe that competition so far has been, or in the future will be, of a price-cutting nature. According to the views of some who follow the market closely, an assurance of material improvement in general business would be followed by a higher price level, while a continuance of present rate of activities would result in a continuance of present quotations.

In the case of sulphuric acid it is reported that prices have varied according to localities. For instance, the lowest prices are said to have been in effect in the South, where the fertilizer trade has taken considerably below its normal quota. Byproduct acid has been more in evidence and this has led some to the belief that acid plants would be forced to compete more keenly in order to protect their markets.

The position of sulphur also has aroused considerable discussion, largely, it seems, on the theory that the general price trend has been downward and that sulphur should follow the general rule.

Chem. & Met. Weighted Index of Chemical Prices

Base = 100 for 1927

This month	**86.37**
Last month	86.26
October, 1930	94.13
October, 1929	100.13

Higher sales prices established for important coal-tar chemicals were responsible for an upward movement of the weighted number. Ethyl acetate also sold at higher levels. Sulphate of ammonia displayed an easy tone, but underwent no quotable change.

Chem. & Met. Weighted Index of Prices for Oil and Fats

Base = 100 for 1927

This month	**47.40**
Last month	51.28
October, 1930	73.84
October, 1929	104.50

While China wood oil maintained a higher average price throughout the period, crude cottonseed, linseed, coconut, and palm oils were lower. Tallow and animal fats likewise were easy in tone and the weighted index number moved downward accordingly.

CURRENT PRICES *in the* NEW YORK MARKET

THE following prices refer to round lots in the New York market. Where it is the trade custom to sell f.o.b. works, quotations are given on that basis and are so designated. Prices are corrected to Oct. 15.

Industrial Chemicals

	Current Price	Last Month	Last Year
Acetone, drums, lb	$0.10 -$0.11	$0.10 -$0.11	$0.11 -$0.12
Acid, acetic, 28%, bbl., cwt	2.60 - 2.85	2.60 - 2.85	2.73 - 2.88
Glacial 99%, tanks	8.98	8.98 -	10.76 -
drs	9.23 - 9.48	9.23 - 9.48	11.01 -
U. S. P. reagent, c'bys	9.73 - 9.98	9.73 - 9.98	11.51 -
Boric, bbl., lb	.06¾- .07	.06¾- .07	.06¾- .07
Citric, kegs, lb	.35 - .36	.35 - .36	.46 - .47
Formic, bbl., lb	.10 - .11	.10 - .11	.10 - .11
Gallic, tech., bbl., lb	.50 - .55	.50 - .55	.50 - .55
Hydrofluoric 30% carb., lb	.06 - .07	.06 - .07	.06 - .07
Latic, 44%, tech., light, bbl., lb	.11½- .12	.11½- .12	.11½- .12
22%, tech., light, bbl., lb	.05½- .06	.05½- .06	.05½- .06
Muriatic 18° tanks, cwt	1.00 - 1.10	1.00 - 1.10	1.00 - 1.10
Nitric, 36°, carboys, lb	.05 - .05½	.05 - .05½	.05 - .05½
Oleum, tanks, wks., ton	18.50 -20.00	18.50 -	18.50 -20.00
Oxalic, crystals, bbl., lb	.11 - .11½	.11 - .11½	.11 - .12
Phosphoric, tech., c'bys., lb	.08½- .09	.08½- .09	.08½- .09
Sulphuric, 60°, tanks, ton	11.00 -11.50	11.00 -11.50	11.00 -11.50
Tannic, tech., bbl., lb	.23 - .35	.23- .35	.35 - .40
Tartaric, powd., bbl., lb	.26½- .27½	.27½- .28½	.34 - .36
Tungstic, bbl., lb	1.40 - 1.50	1.40 - 1.50	1.40 - 1.50
Alcohol, ethyl, 190 p'f., bbl., gal.	2.33 -	2.33 -	2.63 - 2.71
Alcohol, Butyl, tanks, lb	.15¾-	.15¾-	.16¾- .17
Alcohol, Amyl			
From Pentane, tanks, lb	.203-	.203-	.236-
Denatured, 188 proof			
No. 1 special dr., gal	.28 -	.28 -	.40 -
No. 5, 188 proof, dr., gal	.28 -	.28 -	.40 -
Alum, ammonia, lump, bbl., lb	.03½- .04	.03½- .04	.03½- .04
Chrome, bbl., lb	.04½- .05	.04½- .05	.05½- .06
Potash, lump, bbl., lb	.03¼- .04	.03¼- .04	.03 - .03½
Aluminum sulphate, com., bags, cwt	1.25 - 1.40	1.25 - 1.40	1.40 - 1.45
Iron free, bg., cwt	1.90 - 2.00	1.90 - 2.00	1.90 - 2.00
Aqua ammonia, 26°, drums lb.	.02¾- .03	.02¾- .03	.03 - .04
tanks, lb.	.02½- .02¾	.02½- .02¾	.02½- .02¾
Ammonia, anhydrous, cyl., lb.	.15½- .15½	.15½- .15½	.15½-
tanks, lb.	.05¾-	.05¾-	.05¾-
Ammonium carbonate, powd. tech., casks, lb	.10½- .11	.10½- .11	.10½- .11
Sulphate, wks., cwt	1.30 -	1.30 -	1.85 -
Amylacetate tech., tanks, lb., gal.	.16½-	.16 -	.222-
Antimony Oxide, bbl., lb	.08 - .09	.08 - .09	.09 - .10
Arsenic, white, powd., bbl., lb	.04 - .04½	.04 - .04½	.04 - .04½
Red, powd., kegs, lb	.09 - .10	.09 - .10	.09 - .10
Barium carbonate, bbl., ton	56.50 -58.00	56.50 -58.00	58.00 -60.00
Chloride, bbl., ton	63.00 -65.00	63.00 -65.00	64.00 -70.00
Nitrate, cask, lb	.07 - .07½	.07 - .07½	.07 - .07½
Blanc fixe, dry, bbl., lb	.03½- .04	.03½- .04	.03¾- .04
Bleaching powder, f.o.b., wks., drums, cwt	2.00 - 2.10	2.00 - 2.10	2.00 - 2.10
Borax, grain, bags, ton	50.00 -57.00	50.00 -57.00	50.00 -57.00
Bromine, cs., lb	.36 - .38	.36 - .38	.45 - .47
Calcium acetate, bags	2.00 -	2.00 -	2.25 -
Arsenate, dr., lb	.06 - .07	.06 - .07	.07 - .08
Carbide drums, lb	.05 - .06	.05 - .06	.05 - .06
Chloride, fused, dr., wks., ton	20.00 -	20.00 -	20.00 -
flake, dr., wks., ton	22.75 -	22.75 -	22.75 -
Phosphate, bbl., lb	.08 - .08½	.08 - .08½	.08 - .08¼
Carbon bisulphide, drums, lb	.05 - .06	.05 - .06	.05 - .06
Tetrachloride drums, lb	.06½- .07	.06½- .07	.06½- .07
Chlorine, liquid, tanks, wks., lb.	.01¾-	.01¾-	.024-
Cylinders	.04 - .06	.04 - .06	.04½- .06
Cobalt oxide, cans, lb	1.35 - 1.45	1.35 - 1.45	2.10 - 2.25
Copperas, bgs., f.o.b. wks., ton	13.00 -14.00	13.00 -14.00	13.00 -14.00
Copper carbonate, bbl., lb	.08½- .18	.08½- .17	.09 - .18
Cyanide, tech., bbl., lb	.41 - .46	.41 - .46	.45 - .46
Sulphate, bbl., cwt	3.40 - 3.50	3.60 - 3.75	4.10 - 4.25
Cream of tartar, bbl., lb	.21½- .22	.22 - .23	.26 - .27
Diethylene glycol, dr., lb	.14 - .16	.14 - .16	.14 - .16
Epsom salt, dom., tech., bbl., cwt.	1.70 - 2.00	1.70 - 2.00	1.75 - 2.00
Imp., tech., bags, cwt	1.15 - 1.25	1.15 - 1.25	1.15 - 1.25
Ethyl acetate, drums, lb	.06½-	.06 -	.096-
Formaldehyde, 40%, bbl., lb	.06 - .07	.06 - .07	.07¼- .08
Furfural, dr., contract, lb	.10 - .12	.10 - .12	.10 - .12
Fusel oil, crude, drums, gal	1.10 - 1.20	1.10 - 1.20	1.30 - 1.40
Refined, dr., gal	1.80 - 1.90	1.80 - 1.90	1.90 - 2.00
Glaubers salt, bags, cwt	1.00 - 1.10	1.00 - 1.10	1.00 - 1.10
Glycerine, c.p., drums, extra, lb.	.11½- .12	.11½- .12	.13 - .14
Lead:			
White, basic carbonate, dry casks, lb	.07¼-	.07½-	.07¾-
White, basic sulphate, sck., lb.	.07 -	.07 -	.07½-
Red, dry, sck., lb	.07½-	.07¾-	.08¼-
Lead acetate, white crys., bbl., lb.	.11 - .12	.11 - .12	.12 - .13
Lead arsenate, powd., bbl., lb	.10 - .14	.10 - .14	.13 - .14
Lime, chem., bulk, ton	8.50 -	8.50 -	8.50 -
Litharge, pwd., csk, lb	.06½-	.06½-	.07¾-
Lithophone, bags, lb	.04½- .05	.04½- .05	.05½- .06¼
Magnesium carb., tech., bags, lb.	.06 - .06½	.06 - .06½	.06 - .06½
Methanol, 95%, tanks, gal	.33 -	.33 -	.38 -
97%, tanks, gal	.34 -	.34 -	.39 -
Synthetic, tanks, gal	.35½-	.37½-	.40½- .45
Nickel salt, double, bbl., lb	.10½- .11	.10½- .11	.13 - .13½
Single, bbl., lb	.10½- .11	.10½- .11	.13 - .13½
Orange mineral, csk., lb	.09½-	.09¾-	.10¾-
Phosphorus, red, cases, lb	.42 - .44	.42 - .44	.42 - .44
Yellow, cases, lb	.31 - .32	.31 - .32	.31 - .32
Potassium bichromate, casks, lb.	.09 - .09½	.09 - .09½	.09 - .09½
Carbonate, 80-85%, calc., csk., lb	.05 - .05½	.05¼- .06	.05½- .06
Chlorate, powd., lb	.08 - .08½	.08 - .08½	.08½- .09
Cyanide, cs., lb	.55 - .57	.55 - .57	.52 - .55
First sorts, csk., lb	.08¾- .09	.08¾- .09	.08¾- .09
Hydroxide (c'stic potash) dr., lb.	.06¼- .06¾	.06¼- .06¾	.06¼- .06¾
Muriate, 80% bgs., ton	37.15 -	37.15 -	37.15 -
Nitrate, bbl., lb	.05¾- .06	.05¾- .06	.06 - .07¾
Permanganate, drums, lb	.16 - .16½	.16 - .16½	.16 - .16½
Prussiate, yellow, casks, lb	.18½- .19½	.18½- .19	.18½- .19
Sal ammoniac, white, casks, lb	.04½- .05	.04½- .05	.047- .05
Salsoda, bbl., cwt	.90 - .95	.90 - .95	.90 - .95
Salt cake, bulk, ton	16.00 -18.00	16.00 -18.00	15.00 -18.00
Soda ash, light, 58%, bags, contract, cwt	1.15 -	1.15 -	1.32 -
Dense, bags, cwt	1.17½-	1.17½-	1.35 -
Soda, caustic, 76%, solid, drums, contract, cwt	2.50 - 2.75	2.50 - 2.75	2.90 - 3.00
Acetate, works, bbl., lb	.05½- .06	.05½- .05¾	.04 - .05
Bicarbonate, bbl., cwt	1.85 - 2.00	1.85 - 2.00	2.00 - 2.25
Bichromate, casks, lb	.07 - .07½	.07 - .07½	.07 - .07½
Bisulphate, bulk, ton	14.00 -16.00	14.00 -16.00	14.00 -16.00
Bisulphite, bbl., lb	.03¾- .04	.03¾- .04	.03½- .04
Chlorate, kegs, lb	.05¾- .07½	.05¾- .07½	.07 - .08
Chloride, tech., ton	12.00 -14.75	12.00 -14.75	12.00 -14.00
Cyanide, cases, dom., lb	.16½- .17	.16½- .17	.18 - .20
Fluoride, bbl., lb	.07½- .08	.07½- .08	.08 - .09
Hyposulphite, bbl., lb	2.40 - 2.50	2.40 - 2.50	2.40 - 2.50
Nitrate, bags, cwt	1.77 -	2.05 -	2.02 -
Nitrate, casks, lb	.07½- .08	.07½- .08	.07½- .08
Phosphate, dibasic, bbl., lb	.0265 - .03	.0265 - .03	.03½- .03¾
Prussiate, yel. drums, lb	.11½- .12	.11½- .12	.11½- .12
Silicate (30°, drums), cwt	.60 - .70	.60 - .70	.60 - .70
Sulphide, fused, 60-62%, dr., lb.	.02¾- .03½	.02¾- .03	.03½- .04
Sulphite, cyrs., bbl., lb	.03 - .03½	.03 - .03¾	.02 - .03
Sulphur, crude at mine, bulk, ton	18.00 -	18.00 -	18.00 -
Chloride, dr., lb	.05 - .06	.05 - .06	.05 - .06
Dioxide, cyl., lb	.06½- .07	.06½- .07	.07 - .08
Flour, bag, cwt	1.55 - 3.00	1.55 - 3.00	1.55 - 3.00
Tin bichloride, bbl., lb	nom.-	nom.-	nom.-
Oxide, bbl., lb	.27¼-	.27¼-	.34 -
Crystals, bbl., lb	.24 -	.25½-	.27 -
Zinc chloride, gran., bbl., lb	.06½- .06¾	.06½- .06¾	.06½- .06¾
Carbonate, bbl., lb	.10½- .11	.10½- .11	.10 - .11
Cyanide, dr., lb	.41 - .42	.41 - .42	.40 - .41
Dust, bbl., lb	.05¼- .06	.05¼- .06	.07½- .08
Zinc oxide, lead free, bag, lb	.06¾-	.06¾-	.06¾-
5% lead sulphate, bags, lb	.06¾-	.06¾-	.06¾-
Sulphate, bbl., cwt	3.00 - 3.25	3.00 - 3.25	3.00 - 3.25

Oils and Fats

	Current Price	Last Month	Last Year
Castor oil, No. 3, bbl., lb	$0.10½-$0.11	$0.10½-$0.11	$0.11¾-$0.12½
Chinawood oil, bbl., lb	.07¼-	.06¾-	.08½-
Coconut oil, Ceylon, tanks, N. Y. lb	.03¼-	.03¾-	.05¼-
Corn oil crude, tanks, (f.o.b. mill), lb	.05½-	.05¼-	.07¼-
Cottonseed oil, crude (f.o.b. mill), tanks, lb	.03½-	.03¾-	.06¼-
Linseed oil, raw, car lots, bbl., lb.	.072-	.075-	.10 -
Palm, Lagos, casks, lb	.04 -	.04¾-	.05¾-
Niger, casks, lb	.03¾-	.04¾-	.05¼-
Palm Kernel, bbl., lb	.05 -	.05 -	.06¼-
Peanut oil, crude, tanks (mill), lb.	.05 -	.05 -	.07 -
Rapeseed oil, refined, bbl., gal	.42 - .44	.45 - .47	.58 - .60
Soya bean, tank (f.o.b. Coast), lb	nom.-	nom.-	.08½-
Sulphur (olive foots), bbl., lb	.04½-	.04¾-	.06¾-
Cod, Newfoundland, bbl., gal	.35 - .36	.35 - .36	.53 - .55
Menhaden, light pressed, bbl., gal.	.33 - .34	.34 - .36	.47 - .49
Crude, tanks (f.o.b. factory), gal.	.15½-	.17½-	.20 -
Whale, crude, tanks, gal	nom.-	nom.-	- .78
Grease, yellow, loose, lb	.02 -	.02 -	.04¼-
Oleo stearine, lb	.06¾-	.07½-	.03¾-
Red oil, distilled, d.p. bbl., lb	.07¾-	.07¾-	.10¼-
Tallow, extra, loose, lb	.02¾-	.02¾-	.04¾-

Coal-Tar Products

	Current Price	Last Month	Last Year
Alpha-naphthol, crude, bbl., lb	$0.60 -$0.65	$0.60 -$0.65	$0.60 -$0.62
Refined, bbl., lb	.80 - .85	.80 - .85	.80 - .85
Alpha-naphthylamine, bbl., lb	.32 - .34	.32 - .34	.32 - .34
Aniline oil, drums, extra, lb	.14½- .15	.14½- .15	.15 - .16
Aniline salts, bbl., lb	.24 - .25	.24 - .25	.24 - .52

Coal-Tar Products (Continued)

	Current Price	Last Month	Last Year
Benzaldehyde, U.S.P., dr., lb.	1.10 - 1.25	1.10 - 1.25	1.15 - 1.25
Benzidine base, bbl., lb.	.65 - .67	.65 - .67	.65 - .67
Benzoic acid, U.S.P., kgs, lb.	.48 - .52	.48 - .52	.57 - .60
Benzyl chloride, tech., dr., lb.	.30 - .35	.30 - .35	.30 - .35
Benzol, 90%, tanks, works, gal.	.20 - .21	.18 - .19	.21 - .22
Beta-naphthol, tech., drums, lb.	.22 - .24	.22 - .24	.22 - .24
Cresol, U. S. P., dr., lb.	.12½- .14	.12½- .14	.14 - .17
Cresylic acid, 97%, dr., wks., gal.	.54 - .58	.54 - .58	.60 - .70
Diethylaniline, dr., lb.	.55 - .58	.55 - .58	.55 - .58
Dinitrophenol, bbl., lb.	.29 - .30	.29 - .30	.30 - .31
Dinitrotoluen, bbl. lb.	.16 - .17	.16 - .17	.16 - .17
Dip oil 25% dr., gal.	.26 - .28	.26 - .28	.26 - .28
Diphenylamine, bbl., lb.	.38 - .40	.38 - .40	.39 - .40
H-acid, bbl., lb.	.65 - .70	.65 - .70	.68 - .70
Naphthalene, flake, bbl., lb.	.03¾- .04¼	.03¾- .04½	.04½- .05
Nitrobenzene, dr., lb.	.08½- .09	.08½- .09	.08½- .10
Para-nitraniline, bbl., lb.	.51 - .55	.51 - .55	.51 - .55
Para-nitrotoluine, bbl., lb.	.29 - .30	.29 - .31	.29 - .31
Phenol, U.S.P., drums, lb.	.14¼- .15	.14¼- .15	.14¾- .15
Picric acid, bbl., lb.	.30 - .40	.30 - .40	.30 - .40
Pyridine, dr., lb.	1.50 - 1.75	1.50 - 1.80	1.50 - 1.80
R-salt, bbl., lb.	.40 - .44	.40 - .44	.44 - .45
Resorcinal, tech., kegs, lb.	.70 - .80	.70 - .80	1.15 - 1.25
Salicylic acid, tech., bbl., lb.	.33 - .35	.33 - .35	.33 - .35
Solvent naphtha, w.w., tanks, gal.	.26 -......	.25 -......	.28 - .30
Tolidine, bbl., lb.	.86 - .88	.86 - .88	.91 - .93
Toluene, tanks, works, gal.	.30 -......	.27 -......	.35 -......
Xylene, com., tanks, gal.	.26 -......	.24 - .25	.25 - .28

Miscellaneous

	Current Price	Last Month	Last Year
Barytes, grd., white, bbl., ton	$23.00-$25.00	$23.00-$25.00	$23.00-$25.00
Casein, tech., bbl., lb.	.07 - .11	.06 - .11	.12½- .14
China clay, dom., f.o.b. mine, ton	8.00 -20.00	8.00 -20.00	8.00 -20.00
Dry colors:			
Carbon gas, black (wks.), lb.	.03 - .20	.03 - .20	.05 - .22
Prussian blue, bbl., lb.	.35 - .36	.35 - .36	.35 - .36
Ultramine blue, bbl., lb.	.06 - .32	.06 - .32	.06 - .32
Chrome green, bbl., lb.	.27 - .28	.27 - .28	.27 - .30
Carmine red, tins, lb.	5.00 - 5.40	5.00 - 5.40	6.00 - 6.50
Para toner, lb.	.75 - .80	.75 - .80	.77 - .80
Vermilion, English, bbl., lb.	1.55 - 1.60	1.55 - 1.60	1.90 - 2.00
Chrome yellow, C. P., bbl., lb.	.16½- .17	.16½- .17	.17 - .17½
Feldspar, No. 1 (f.o.b. N.C.), ton	6.50 - 7.50	6.50 - 7.50	6.50 - 7.50
Graphite, Ceylon, lump, bbl., lb.	.07 - .08½	.07 - .08½	.04 - .05
Cum copal Congo, bags, lb.	.06 - .08	.06 - .08	.07½- .08
Manila, bags, lb.	.16 - .17	.16 - .17	.16 - .17
Damar, Batavia, cases, lb.	.16 - .16½	.16 - .19	.18 - .19
Kauri No. 1 cases, lb.	.45 - .48	.45 - .48	.48 - .53
Kieselguhr (f.o.b. N.Y.), ton	50.00 -55.00	50.00 -55.00	50.00 -55.00
Magnesite, calc, ton	40.00 -......	40.00 -......	40.00 -......
Pumice stone, lump, bbl., lb.	.05 - .07	.05 - .08	.05 - .07
Imported, casks, lb.	.03 - .40	.03 - .40	.03 - .35
Rosin, H., bbl.	4.05 -......	4.25 -......	5.60 -......
Turpentine, gal.	.36 -......	.38 -......	.41½-......
Shellac, orange, fine, bags, lb.	.38 - .40	.38 - .40	.43 - .44
Bleached, bonedry, bags, lb.	.28 - .30	.28 - .30	.28 - .30
T. N. bags, lb.	.16 - .17	.16 - .17	.21 - .22
Soapstone (f.o.b. Vt.), bags, ton	10.00 -12.00	10.00 -12.00	10.00 -12.00
Talc, 200 mesh (f.o.b. Vt.), ton	8.00 - 8.50	8.00 - 8.50	9.50 -......
300 mesh (f.o.b. Ga.), ton	7.50 -10.00	7.50 -10.00	7.50 -11.00
225 mesh (f.o.b. N. Y.), ton	13.75 -......	13.75 -......	13.75 -......

	Current Price	Last Month	Last Year
Wax, Bayberry, bbl., lb.	$0.19½-$0.22	$0.19½-$0.22	$0.21 -$0.24
Beeswax, ref., light, lb.	.25 - .27	.26 - .27	.34 - .36
Candelilla, bags, lb.	.13 - .14	.13 - .14	.17 - .20
Carnauba, No. 1, bags, lb.	.33 - .34	.35 - .36	.28 - .29
Paraffine, crude			
105-110 m.p., lb.	.03⅛- .03¼	.03⅛- .03¼	.04⅞- .05

Ferro-Alloys

	Current Price	Last Month	Last Year
Ferrotitanium, 15-18%, ton	$200.00-.....	$200.00-.....	$200.00-.....
Ferromanganese, 78-82%, ton	80.00-85.00	80.00-85.00	94.00-99.00
Ferrochrome, 65-70%	.11-.....	.11-.....	....
Spiegeleisen, 19-21%, ton	30.00-.....	30.00-.....	33.00-.....
Ferrosilicon, 14-17%, ton	31.00-.....	39.00-.....	39.00-.....
Ferrotungsten, 70-80%, lb.	1.00- 1.10	1.00- 1.10	1.20-.....
Ferrovanadium, 30-40%, lb.	3.15- 3.50	3.15- 3.50	3.15- 3.50

Non-Ferrous Metals

	Current Price	Last Month	Last Year
Copper, electrolytic, lb.	$0.07 -......	$0.07½-......	$0.10 -......
Aluminum, 96-99%, lb.	.233-......	.233-......	.233-......
Antimony, Chin. and Jap., lb.	.065-......	.066-......	.075-......
Nickel, 99%, lb.	.35 -......	.35 -......	.35 -......
Monel metal blocks. lb.	.28 -......	.28 -......	.28 -......
Tin 5-ton lots, Straits, lb.	.22¼-......	.25¾-......	.268-......
Lead, New York, spot, lb.	.04 -......	.044-......	.0505-......
Zinc, New York, spot, lb.	.035-......	.0415-......	.0445-......
Silver, commercial, oz.	.29⅛-......	.28 -......	.36⅛-......
Cadmium, lb.	.55 -......	.55 -......	.70 -......
Bismuth, ton lots, lb.	1.50 -......	1.50 -......	1.00 -......
Cobalt, lb.	2.50 -......	2.50 -......	2.50 -......
Magnesium, ingots, 99%, lb.	.30 -......	.48 -......	.65 - 1.00
Platinum, ref., oz.	40.00-......	40.00-......	43.00-......
Palladium ref., oz.	19.00- 21.00	19.00- 21.00	23.00- 24.00
Mercury, flask, 75 lb.	74.00- 76.00	80.00-......	110.00-113.00
Tungsten powder, lb.	1.45-......	1.65-......	1.70- 1.75

Ores and Semi-finished Products

	Current Price	Last Month	Last Year
Bauxite, crushed, wks., ton	$6.50 -$8.25	$6.50 -$8.25	$7.50 -$8.00
Chrome ore, c.f. post, ton	17.00 -20.00	17.00 -20.00	21.50 -25.00
Coke, fdry., f.o.b. ovens, ton	2.75 - 2.85	2.75 - 3.85	2.75 - 2.85
Fluorspar, gravel, f.o.b. Ill., ton	17.25 -20.00	17.25 -20.00	18.00 -20.00
Manganese ore, 50% Mn., c.i.f. Atlantic Ports, unit	.25 - .26	.24 - .25	.31 - .36
Molybdenite, 85% MoS_2 per lb. MoS_2, N. Y., lb.	.45 -......	.35 - .40	.48 - .50
Monazite, 6% of ThO_2, ton	60.00 -......	60.00 -......	60.00 -......
Pyrites, Span. fines, c.i.f., unit	.13 -......	.13 -......	.13 -......
Rutile, 94-96% TiO_2, lb.	.10 - .11	.10 - .11	.10 - .11
Tungsten, scheelite, 60% WO_3 and over, unit	9.50 -12.00	11.25 -12.00	15.25 -16.50

CURRENT INDUSTRIAL DEVELOPMENTS

New Construction and Machinery Requirements

Asphalt Plant—H. D. Barndollar and W. L. Kepner, Joplin, Mo., will build an asphalt manufacturing plant near Ellis. Estimated cost $100,000. Private plans.

Chemical Plant—D. & G. Chemical Co., F. L. Lofgren, Pres., Calumet City, Ill., plans reconstruction of plant destroyed by fire. Estimated cost to exceed $100,000. Maturity indefinite.

Chemical Plant—Fields Chemical Corp., Ltd., c/o R. D. Van Alstine, 410 East 9th St., Long Beach, Calif., Engr., is having plans prepared for the construction of a plant including administration buildings, laboratory and pump houses, etc., on Cherry Ave., Long Beach. Estmated cost $50,000.

Chemical Plant—Pacific States Pulp & Paper Co., c/o L. E. Van Winkle, Secy., 414 Fernell Bldg., Spokane, Wash., plans the construction of first unit of plant for the manufacture of salt cake for paper pulp at Priest River, Idaho. $50,000. Estimated total cost $1,000,000.

Chemical Plant—Southern Alkali Corp., c/o American Cyanamid Corp., 535 5th Ave., New York, N. Y., will receive bids about Jan. 1 for the construction of first unit of chemical plant at Corpus Christi, Tex. Estimated total cost $10,000,000. Private plans.

Chemical Plant—Stauffer Chemical Co., 624 California St., San Francisco, Calif., awarded contract for the design and construction of two additional plant buildings for the manufacture and storage of fertilizer products, 88 x 140 and 36 x 60 ft. at Vernon to Austin Co., 16112 Euclid Ave., Cleveland, O. Estimated cost $50,000.

China Factory—Edwin M. Knowles China Co., Newell, W. Va., awarded contract for a 1 story factory to house new tunnel kiln now under construction to Joseph Finley Co., Chester. Estimated cost $50,000.

China Factory—Mayer China Co., Beaver Falls, Pa., plans to rebuild factory recently destroyed by fire. Carlisle & Sharrer, Martin Bldg. N. S., Pittsburgh, are architects.

Decalcomania Factory — Di-Nock Mfg. Co., Keith E. Weigle, Pres., 875 East 140th St., Cleveland, O., manufacturers of decalcomania materials, plans the construction of a factory. Estimated cost $50,000. Architect not selected.

Colortype Plant—American Colortype Co., 207 West 25th St., New York, N. Y., awarded contract for alterations to plant at Allwood, N. J., to M. C. Tredennick & Sons, Inc., 25 West 45th St., New York. Estimated cost $40,000.

Electroplating Plant—Mountain Electroplating & Rustproofing Co., c/o William H. Raschke, 2300 Elizabeth St., Pueblo, Colo., plans to remodel warehouse and purchase new equipment for plant.

Enamel Factory—Allen Manufacturing Co., New Durham, N. H., plans to rebuild enamel factory destroyed by fire. Loss $25,000 to $40,000.

Fertilizer Plant—American Fertilizer & Chemical Works, Inc., Box 35 Station A., San Antonio, Tex., wants prices on equipment for the manufacture of fertilizers including bags, cotton and burlap, nitrogen, phosphoric acid and potash for proposed plant at San Antonio, also mixing and weighing machines for plant at San Saba.

Film Manufacturing Plant—Eastman Kodak Co., 343 State St., Rochester, N. Y., plans reconstruction of film manufacturing plant destroyed by fire. Estimated cost to exceed $40,000.

Furnace—Dept. of Public Works, Wellington, N. Z., will receive bids until Dec. 1 for one electrical heating furnace for annealing cast iron Pelton wheel buckets.

Coke Pockets, Etc.—Consolidated Gas Co., 4 Irving Pl., New York, N. Y., plans the construction of two coke pockets at 427 East 110th St., also 1 story, 35 x 141 ft. pump house and tar separating pit at Bronx River and Hunts Point and Bay View Aves. Estimated total cost $80,000.

Gas Plant—City Gas & Electric Corp., Quebec City, Que., plans erection of a gas plant at Three Rivers. Initial cost $500,000.

Gas Plant — City of Two Harbors, Minn., awarded contract for the construction of a Butane gas plant and distribution system to R. O. Moore & Co., Tulsa National Bank Bldg., Tulsa, Okla.

Gas Plant—Council of Fort William, Ont., has approved agreement and ratepayers are to vote Oct. 17 on proposal of Hamilton By-Product Coke Ovens, Ltd., 15 Main St., E., Hamilton, to construct a gas plant at Fort William. $1,500,000.

Gas Plant—New York & Richmond Gas Co., 691 Bay St., St. George, S. I., New York, plans the construction of an artificial gas plant at Honeywood. Estimated cost $125,000. Private plans.

Gas Plant—Oregon Natural Gas Co., Portland, Ore., plans installation of pipes and central plant for distribution of natural gas at The Dalles, Ore. Estimated cost $80,000.

Plant—California Carbonic Ice Mfg. Co., c/o C. A. Winder, 200 Bush St., San Francisco, Calif., is having plans prepared for a plant for the manufacture of ice from gases of sub-station stacks at 23rd and Illinois Sts. Estimated cost $250,000.

Glass Factory—Owens-Illinois Glass Co., W. I. Cole, Mgr., 133 Kearny St., San Francisco, Calif., is having plans prepared for a glass factory at Alameda. Estimated cost $1,000,000. Mills, Rhines, Bellman & Nordhoff, Inc., Ohio Bldg., Toledo, O., are engineers.

Glass Manufacturing Plant—Corp., c/o George C. Stewart & Associates, Butler, Pa., has work under way on reconditioning former plant of Standard Plate Glass Co. at Butler. Estimated cost to exceed $40,000.

Laboratory—Babcock & Wilcox Co., East Third St., Bayonne, N. J., completed plans for a 4 story laboratory building. Estimated cost $50,000. Private plans.

Laboratory—Connecticut Agricultural Experimental Station, W. L. Slate, Huntington Road, New Haven, Conn., will soon award contract for the construction of an experimental and agricultural laboratory. Estimated cost $50,000. Douglas Orr, 956 Chapel St., New Haven, is architect.

Laboratory — Grasselli Chemical Co., Henry Gronemeyer, Ch. Engr., Guardian Bldg., Cleveland, O., awarded contract for a 3 story, 31 x 54 ft. laboratory to Lundoff-Bicknell Co., B. F. Keith Bldg., Cleveland. Estimated cost $60,000.

Laboratory—Rockefeller Institute, York Ave. and 66th St., New York, N. Y., will receive bids about Nov. 1 for the construction of a laboratory of animal and plant pathology at Princeton, N. J. Estimated cost $150,000. Coolidge, Shepley, Bulfinch & Abbott, Ames Bldg., Boston, are architects.

Laboratory—(Citrus By-Products)—Bureau of Chemistry & Soils, Washington, D. C., plans establishing a citrus by-products laboratory at Mercedes, Tex. Private plans.

Laboratory (Pharmaceutical and Medical)—Eli Lilly Co., Alabama and McCarty Sts., Indianapolis, Ind., awarded contract for a 4 story, 50 x 222 ft. pharmaceutical and medical laboratory to Leslie Colvin, Continental Bank Bldg., Indianapolis. Estimated cost $500,000.

Laboratories—Architects Office, Board of Education, Louisville, Ky., is having plans prepared for a girls high school including laboratories, etc., at Third and Shipp Sts. Estimated cost $900,000. J. M. Colley, c/o owner, is architect.

Laboratories—Board of Commissioners, J. Wasser, Clk., City Hall, Jersey City, N. J., is having preliminary plans prepared for three laboratory and two hospital buildings at Medical Centre. Estimated cost $5,000,000. John T. Rowland, Jr., 30 Journal Sq., Jersey City, is architect.

Paper Mill—De Pere Paper & Mfg. Co., c/o M. Miller, Pres., De Pere, Wis., plans to rebuild paper mill destroyed by fire. Estimated cost $50,000. Architect not selected.

Paper Manufacturing Plant — Muller Paper Goods Co., 2350 Linden Blvd., Ridgewood, N. Y., will soon award contract for altering and constructing plant addition. Estimated cost $75,000. H. Brucker, 1037 Kossuth Pl., Glendale, is architect.

Paper Plant Additions—Pioneer Paper Co., 5500 South Alameda St., Los Angeles, Calif., purchased site adjoining present plant and plans additions and improvements.

Polish Factory—C. H. McAleer Mfg. Co., 7401 Lyndon Ave., Detroit, Mich., awarded contract for design and construction of a 1 story automobile polish factory to Austin Co., General Motors Bldg., Detroit. Estimated cost $50,000.

Bulk Oil Plant—Standard Oil Co. of Pennsylvania, W. E. Black, in charge, Peoples Gas Bldg., Pittsburgh, Pa., awarded contract for a bulk oil plant to include 1 story, 32 x 89 ft. garage, six trucks and office building; vertical and horizontal tanks; 50 x 100 ft. warehouse; 14 x 16 ft. pump house, two loading platforms; septic tank and sewage disposal system at Johnstown to Wilson Construction Co., Schenkemeyer Bldg., Bedford St., Johnstown.

Bulk Oil Plant—Standard Oil Co. of New Jersey, 185 Washington St., Newark, N. J., awarded contract for a group of buildings for bulk oil plant, 2 story, 60 x 95 ft., 1 story, 40 x 40 ft., 1 story, 20 x 30 ft. and 1 story, 40 x 40 ft. to Karno Smith Construction Co., Broad St. Bank Bldg., Trenton. Estimated cost $150,000.

Refinery—Atlantic Refining Co., Keyser Bldg., Baltimore, Md., plans to rebuild refinery at Key Highway and Lawrence St. Eleven storage tanks will be relocated and two more constructed.

Refinery — Coastal Petroleum Corp., Mobile, Ala., awarded contract for the construction of a refinery 5,700 bbl. daily capacity at Blakely Island to J. T. Devine Mfg. Co., Mount Vernon, Ill., and 25 West 43rd St., New York, N. Y. Will use Pratt vapor phase cracking process.

Refinery—Hartman Interests, Inc., c/o H. W. Hartman, V. Pres., Gulf Bldg., Houston, Tex., will build an oil refinery 25,000 bbl. capacity. Estimated cost $2,500,000. Mark Lents, Houston, is chief engineer. Work will be done by owners forces.

Refinery—Emile Snyder, Inc., 306 South St., Newark, N. J., plans to rebuild refinery at 298-306 South St. Estimated cost $40,000. Architect not selected.

Refinery—Pan-American Petroleum Corp., c/o O. D. Barker, American National Insurance Bldg., Galveston, Tex., acquired a site and surveys are under way for the construction of a large refinery, also laying pipe lines to East Texas oil fields, Texas City. Estimated cost $1,000,000.

Refineries (Oil)—Humble Oil & Refining Co., Humble Bldg., Houston, Tex., is having surveys made for the construction of a refinery at Pitner Junction, Kilgore and Gladewater. Estimated total cost $1,000,000.

Refinery (Oil)—Louisiana Oil Refining Co., 1115 Southern St., Memphis, Tenn., subsidiary of Cities Service Co., 60 Wall St., New York and Arkansas Natural Gas Co., Conway Pike, Little Rock, Ark., awarded contract for the construction of a warehouse to H. H. Walsh, Dermon Bldg., Memphis. Estimated cost $25,000.

—Refinery (Oil)—Imperial Oil Refineries, Ltd., East Montreal, Que., awarded contract for the construction of a separator to Walter G. Hunt, Ltd., 1405 Bishop St., Montreal. Estimated cost $50,000.

Rubber Factory—Panco Rubber Co., M. Birnstein, 31 Highland Ave., Chelsea, Mass., will soon award contract for a 2 story storage building at Highland Ave. and Congress St., Chelsea. Estimated cost $40,000. S. Schein, 333 Washington St., Boston, is architect.

Silk Hosiery Plant—Real Silk Hosiery Co., 514 North Davidson St., Indianapolis, Ind., awarded contract for the constructon of a plant to Mead Construction Co., 1027 Lemcke Bldg., Indianapolis. Estimated cost $40,000.

Soap Factory—Los Angeles Soap Co., 617 East First St., Los Angeles, is having plans prepared for first unit of factory, 2 story, 140 x 268 ft. including tanks, six large steel rolling shutters, etc. Estimated cost $200,000. Morgan, Wells & Clements, 1135 Van Nuys Bldg., Los Angeles, are architects.

Tallow Plant—Schonwalter Tallow Co., Woodruff Lane, Elizabeth, N. J., is having plans prepared for reconstruction of plant. Estimated cost $40,000 including equipment. Maturity soon.

Factory Addition—United Shank & Findings Co., c/o United Shoe Machinery Corp., 140 Federal St., Boston, Mass., will soon award contract for addition and alterations to factory. Estimated cost $40,000. C. W. Hull, c/o owner, is architect.

Factory Addition—Vellumoid Co., 54 Rochdale St., Worcester, Mass., awarded contract for a 1 story, 30 x 65 ft. addition to factory to A. J. Daniels, Shrewsbury.

INDUSTRIAL NOTES

INTERNATIONAL-STACEY CORP. has transferred C. B. Coldwell from its Chicago office to the office at 1309 Aviation Bldg., Fort Worth, Texas.

PENNSYLVANIA PUMP & COMPRESSOR CO., Easton, Pa., has formed a business connection with Byer Engineering Associates, Easton, Pa., with branch offices at 136 Liberty St., New York, and 1328 Chestnut St., Philadelphia.

GOSLIN-BIRMINGHAM MFG. CO. has removed its New York office to 136 Liberty St.

KALBFLEISCH CORP. has appointed E. Y. Burkhalter as sales manager of its rosin division in New York.

L. H. GILMER CO., Philadelphia, has appointed Charles H. Bauer general sales manager.

DUNBAR ENGINEERING CO., New York, representative for the Edwards Valve & Mfg. Co., has opened a Philadelphia office under L. W. Tremblay.

WESTINGHOUSE ELECTRIC & MFG. CO. has appointed Bernard Lester and C. B. Stainback, assistant sales managers in its industrial division.

PATTERSON FOUNDRY & MACHINE CO., East Liverpool, Ohio, have opened a San Francisco office in the Rialto Bldg., with E. S. Downing in charge.

BIGGS BOILER WORKS CO., Akron, Ohio, has appointed Alfred E. Fickes as sales manager.

ASIATIC PETROLEUM CORP. has moved its New York offices to 80 Broad Street.

FOSTER WHEELER CORP., New York, has appointed H. L. Robertson as general sales manager.

THE TIMKEN ROLLER BEARING CO., Canton, Ohio, has elected F. J. Griffiths as director and president of the Timken Steel & Tube Co.

CHICAGO PNEUMATIC TOOL CO., New York, has moved its Seattle, Washington, office to 3201 First Ave. S., with C. K. Hillman in charge.